DESIGN & TECHNOLOGIES

TEACHER RESOURCE

YEAR 7-8

THINKING OUTSIDE THE BOX

THE SUSTAINABLE SEATING PROJECT

DOWNLOAD YOUR FORESTVR™ APP

AUSTRALIAN CURRICULUM LINKS

AC9TDE8K01
AC9TDE8K04
AC9TDE8K06
AC9TDE8P01
AC9TDE8P02
AC9TDE8P03
AC9TDE8P04
AC9TDE8P05

For State Curriculum links go to page 38.

INTRODUCTION

ForestLearning and the Design and Technologies Teachers Association of Victoria (DATTA Vic) have developed this eight-lesson resource to align with Version 9.0 Australian Curriculum Years 7-8 Design and Technologies.

Students will investigate the properties and sustainability of materials including cardboard and explore the importance of sustainable forest management to produce wood pulp for the manufacture of cardboard.

Using ForestVR 360° videos, students go on virtual excursions to an Australian pine plantation and paper mill to experience the cycle of growing sustainable wood fibre and how it is processed into paperboard. Following the design thinking process, students investigate, design, produce and evaluate a sustainable seat made from upcycled cardboard.

ForestLearning, in partnership with the DATTA Vic, respectfully acknowledges the Traditional Custodians of the land and their Elders past and present, for the important and enduring role that Aboriginal and Torres Strait Islander peoples play in Australia regarding the land, water and sky.

DATTA VICTORIA Design And Technology Teachers Association

FOREST LEARNING

RATIONALE

This unit of work guides students from start to completion of a cardboard seat project following the steps of the product design process as illustrated below. It is divided into 8 × 2-hour lesson blocks that can be taught over one school term.

Alternatively, individual lessons or activities can be used to explore particular aspects of the curriculum. For example, Lesson 1 explores the sustainability of different materials, particularly cardboard and could be used to precede any project that uses cardboard or paper-based materials.

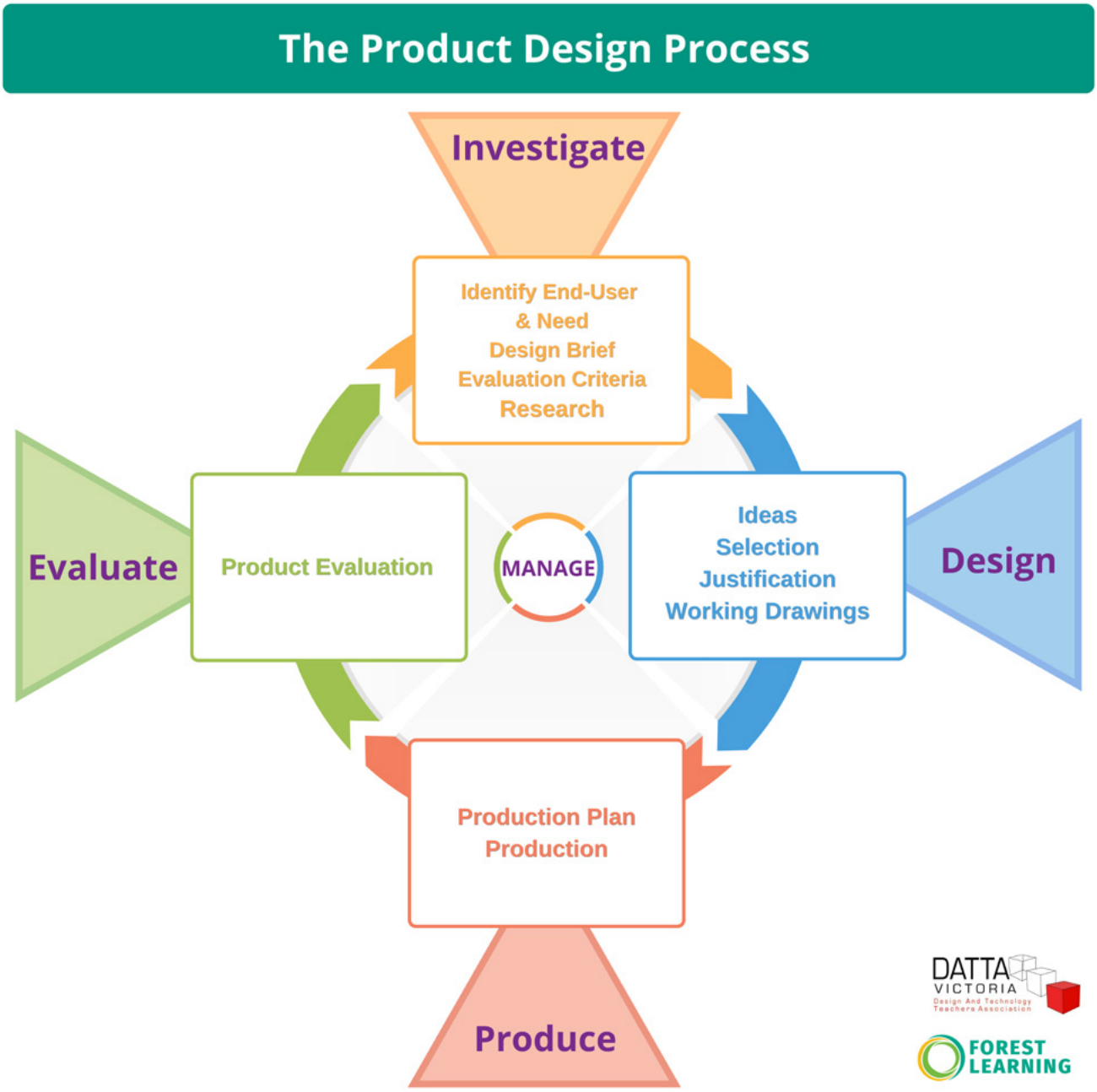


Image adapted from DATTA Vic, The Product Design Process Poster https://datta.vic.edu.au/Sys/Store/Products/297733

TEACHER PREPARATION

- Find a source of corrugated cardboard for students to build their cardboard seats.
- Ensure you have the tools that the students will need to create their cardboard seats, including cutting mat, utility knives, hobby (xacto knives), scissors, hot glue gun, tapes, pencils and texters.
- Consider safety and the provision of aprons, safety glasses and gloves for students.

LESSON SEQUENCE

INVESTIGATING & DEFINING

LESSON 1

THINKING OUTSIDE THE CARDBOARD BOX - page 6

AIM

Students explore cardboard products used in their daily lives, the life cycle of cardboard and cardboard in a circular economy.

OUTCOMES

Students will:

- Consider how they rely on and use cardboard products in their daily lives and generate ideas for future cardboard innovations.
- Undertake immersive Virtual Reality (VR) 360° video excursions to explore the manufacturing process of cardboard and the origin of the sustainable wood fibre used in its production.
- Understand cardboard as part of a circular economy that can work to reduce waste to landfill, creating a flowchart to demonstrate the life cycle of cardboard as a sustainable material.

LESSON 2

RESEARCH FOR A CARDBOARD SEAT - page 14

AIM

To investigate attitudes towards cardboard seats and analyse seat materials and designs.

OUTCOMES

Students will:

- Create and conduct a targeted survey to identify needs and opportunities for cardboard seats.
- Analyse the benefits and disadvantages of three existing seat designs.
- Identify and justify a suitable material for a seat based on research results.
- Research cardboard seat designs to find inspiration and develop ideas.

GENERATING & DESIGNING

LESSON 3

GENERATING A CARDBOARD SEAT DESIGN - page 23

AIM

To generate a design brief and communicate cardboard seat design ideas.

OUTCOMES

Students will:

- Write a design brief using information gathered from surveys and research.
- Generate ideas that reflect an understanding of the properties of cardboard.
- Create and communicate a final design using annotated sketches and graphical representation techniques.

LESSON 4

RISK ASSESSMENT AND PROTOTYPE PRODUCTION - page 29

AIM

To complete a risk assessment and identify safe work practices, as well as to develop skills for working with cardboard whilst creating a prototype.

OUTCOMES

Students will:

- Select suitable materials and equipment to make a cardboard seat.
- Measure and mark out cardboard to make a prototype.
- Join cardboard using hot glue and slots.
- Identify and apply safe work procedures.

PRODUCING & IMPLEMENTING

LESSONS 5-7

CARDBOARD SEAT PRODUCTION - page 32

AIM

To produce a cardboard seat that meets the needs outlined in the design brief.

OUTCOMES

Students will:

- Follow a production sequence to produce their final seat, using their time effectively.
- Develop spatial skills and building techniques working with cardboard.
- Apply safe work procedures.

EVALUATING

LESSON 8

EVALUATION AND PRESENTATION OF FINISHED UPCYCLED CARDBOARD SEATS - page 34

AIM

For students to evaluate their materials selection, design process and production outcomes, summarise their knowledge and skills, and gather feedback on their finished product.

OUTCOMES

Students will:

- Complete an evaluation of their final cardboard seat product.
- Develop communication and presentation skills through presenting their final product to an audience.
- Provide constructive written feedback to peers following class presentations.

CURRICULUM OVERVIEW

For ease of reference, the table below outlines the Version 9.0 Australian Curriculum Years 7-8 Design and Technologies strands, content descriptions and their aligned lessons as covered in 'Sustainable Seating Project - Cardboard'. Victoria State curriculum alignment can be found on page 38.

AUSTRALIAN CURRICULUM VERSION 9.0		
STRAND	**YEARS 7 & 8 CONTENT DESCRIPTIONS**	**LESSONS**
Knowledge and Understanding	Analyse how people in design and technologies occupations consider ethical and sustainability factors to design and produce products, services and environments. **AC9TDE8K01**	1, 2
	Analyse how food and fibre are produced in managed environments and how these can become sustainable. **AC9TDE8K04**	1
	Analyse how characteristics and properties of materials, systems, components, tools and equipment can be combined to create designed solutions. **AC9TDE8K06**	2, 3
Processes and Production Skills	Analyse needs or opportunities for designing, and investigate and select materials, components, tools, equipment and processes to create designed solutions. **AC9TDE8P01**	3, 4
	Generate, test, iterate and communicate design ideas, processes and solutions using technical terms and graphical representation techniques, including using digital tools. **AC9TDE8P02**	3, 4
	Select, justify and use suitable materials, components, tools, equipment, skills and processes to safely make designed solutions. **AC9TDE8P03**	3, 4, 5, 6, 7
	Develop design criteria collaboratively including sustainability to evaluate design ideas, processes and solutions. **AC9TDE8P04**	3, 8
	Develop project plans to individually and collaboratively manage time, cost and production of designed solutions. **AC9TDE8P05**	5, 6, 7

KEY

STUDENT STEP / TASK QUESTION TEACHER STEP

LESSON 1

THINKING OUTSIDE THE CARDBOARD BOX

120 minutes

For each question, teacher answers are provided on blue.

AIM

Students explore cardboard products used in their daily lives and around the home, including the life cycle of cardboard and cardboard as part of a circular economy.

OUTCOMES

Students will:

- Consider how they rely on and use cardboard products in their daily lives, creating a mind map that demonstrates their understanding and ideas for innovative uses of cardboard into the future.
- Undertake immersive Virtual Reality (VR) 360° video excursions to explore the manufacturing process of cardboard and where the sustainable wood fibre used in its production originates.
- Understand cardboard as part of a circular economy that can work to reduce waste to landfill, creating a flowchart to demonstrate the life cycle of cardboard as a sustainable material.

FURTHER TEACHER INFORMATION - ForestVR™

- For more information about the use of ForestVR™ app in the classroom, including the classroom-ready Teacher Sync functionality go to: **https://forestlearning.edu.au/find-a-resource/article/86/forestvr-how-to-use-the-classroom-synchronisation-tool-on-forestvr-apps.html**
- Make your own (DIY) VR Headset
  - ForestLearning short activity instructions + printable template - Create your own Virtual Reality Headset: **https://forestlearning.edu.au/find-a-resource/article/109/forestvr-short-activity-create-avirtual-reality-headset.html**
  - VR Safety poster to download and display for the classroom: **https://vrschoolresearch.com/2017/09/10/the-be-vr-aware-classroom-posters/**

MATERIALS

- Projection screen
- Technology to view ForestVR™ 360° videos - student iPad/computer, VR headsets or materials to make them and smartphone (optional, see this **link** for details).
- A4 folder/workbook
- Paper
- Markers

TEACHER PREPARATION

- Set up a display of cardboard products from around the home.
- Bring in:
  - cardboard packages/samples of cardboard
  - cardboard product items of varying thicknesses students can use to explore the properties of cardboard such as cups, cereal boxes, amazon boxes, smart phone boxes etc.
- Access to a projector screen.
- 360° ForestVR™ videos can be watched on any device capable of watching YouTube or Vimeo including VR Headset, whole class smart board or projector screen using a teacher laptop, or individual student devices such as iPad/laptop.

ACTIVITY 1

CARDBOARD, CARDBOARD EVERYWHERE!

AIM

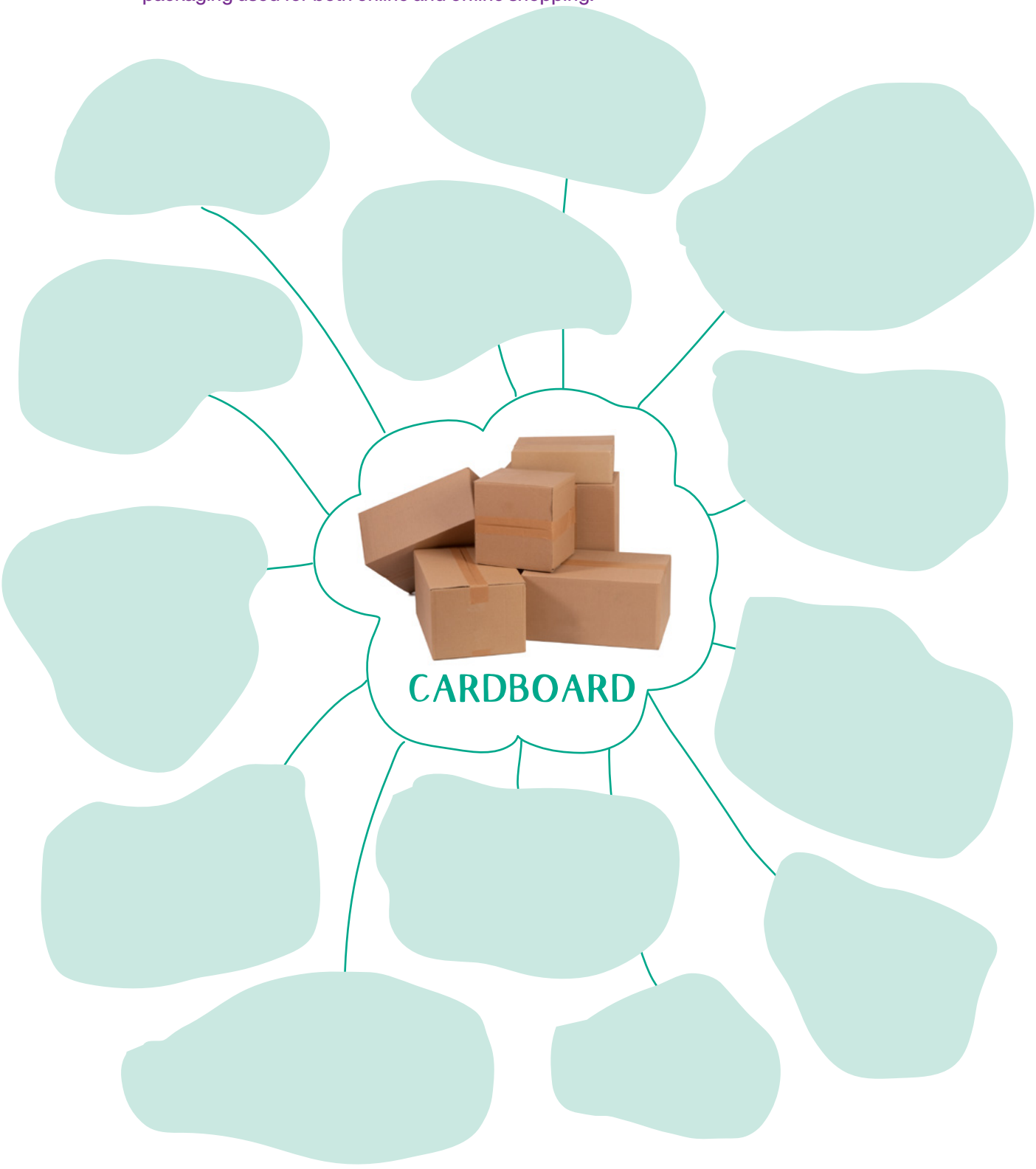
To explore current and potential innovative uses of cardboard through collaborative discussion and mind maps.

30 minutes

small groups

STEP 1 **Allow students to explore and touch the range of different cardboard products on display.**

STEP 2 **In small groups, students discuss ways cardboard is used around their homes and in society. Ask each student to create a** mind map **to show cardboard uses.** Suggested example: the types of packaging used for both online and offline shopping.



STEP 3 **In small groups, students explore the properties of 3 cardboard product samples and discuss why cardboard is so widely used as a packaging material. You may wish to set up a material properties test as outlined below.**

OPTIONAL EXTENSION

Set up a small practical task using a variety of different cardboard packaging options (such as an Amazon box or similar, cardboard coffee cup, cereal packaging, electrical appliance packaging, fruit box, new phone packaging) and allow students to perform different tests for strength, moisture repelling, foldability, durability on each such as pouring water on them (water resistance), trying to tear them (strength), drop them (durability), crush them (strength) etc. Ask students to create a short description for each sample and record in the table below. Students can also rate the samples from 1 to 3, from best to worst performing on each test.

Table 1. Different Cardboard Product Properties Test.

CARDBOARD PROPERTIES	OBSERVATION AND RATING		
	SAMPLE 1	SAMPLE 2	SAMPLE 3
Strength - Fold test 			
Strength - Crush test 			
Durability - Tear test 			
Durability - Drop test 			
Water Repellent - Water test 			
Optional Other:			

QUESTION 1 List 3 reasons cardboard is commonly used as a packaging material, based on the properties you have discovered in your samples.

It is strong and robust, moisture repelling, can be folded into any shape or size and is customisable (easily printed on for advertising/brand recognition). It is low cost, biodegradable and can be sustainably sourced. (Source: https://www.productionpackaging.com.au/news/cardboard-packaging-unparalleled-versatility).

STEP 4 In their groups, students brainstorm what other products cardboard could be used for. Show them the examples below:

- Cardboard for temporary housing (https://www.cardborigami.org/).
- Take a virtual tour of a cardboard cathedral in Christchurch (https://www.google.co.nz/maps/@-43.5320917,172.6430555,3a,75y,179.93h,103.53t/data=!3m6!1e1!3m4!1s77QXbv6O7IYAAAQJOH1jbw!2e0!7i13312!8i6656).
- Cardboard furniture (https://www.papertigerproducts.com/).

Cardboard for temporary housing

Cardboard cathedral in Christchurch

Cardboard furniture

STEP 5 Students add these innovative ideas for cardboard products and uses to their mind map using a different colour/symbology.

ACTIVITY 2 A SIMPLE PRODUCT - A COMPLEX PROCESS: HOW IS CARDBOARD MADE?

AIM

To investigate where the wood fibre that goes into cardboard material comes from and how it is grown sustainably; how cardboard is manufactured, its properties and why it is considered a sustainable material.

60 minutes

pairs and individual

TEACHING INSTRUCTIONS

There are two 360° videos for students to watch, found on the ForestLearning website:

1. Growing trees for wood (**https://forestlearning.edu.au/forestvr/article/1/pine-the-renewable-pine-forest-story-experiences.html**).
2. The manufacturing process of paper and cardboard (**https://forestlearning.edu.au/forestvr/article/4/pine-plantation-to-paper.html**).

You may like to choose from the following options:

- Students all watch both the videos using individual VR headsets or YouTube/Vimeo capable devices.
- Students watch both the videos as a class using a smart board/projector screen.
- Students work in pairs using individual devices. Each student watches only one video, then finds someone else in the room who also watched the same video to compare notes. They return to their pairs and tell one another about the video and the processes involved for each.

STEP 1 Watch 'The renewable pine plantation forest story' ForestVR 360° video (https://forestlearning.edu.au/forestvr/article/1/pine-the-renewable-pine-forest-storyexperiences.html), then answer the following questions.

QUESTION 1 From the video, identify two types of technology used in the forest cycle and explain how this is used within the forest industry.

Examples include:

- Automated sowing line in the nursery makes planting efficient and consistent.
- Laboratory foliar sampling and testing to monitor tree and forest health.
- LiDAR to measure the forest remotely.
- Digital mapping and modelling software to work out sustainable yield.
- Harvester machines that contain optimisers to cut trees down and process them into the best products efficiently.
- Forwarder and Loader machines to sort, move and stack logs.
- Chopper Roller machine to chop up the leftover branches and stumps (slash) after harvesting to prepare the site for planting, (removing the need to burn the slash).

QUESTION 2 Briefly outline two sustainable features of the pine plantation forest life cycle.

1. The plantations are always replanted after harvesting.
2. The plantations are managed to ensure high productivity (and reduce time to grow to maturity) by controlling weeds and only applying nutrients as required to ensure forest health.
3. Technology is used to monitor and model forest growth as well as to maximise the products cut from the trees and minimise waste.
4. Chopping up the branches and stumps after harvesting rather than burning it, reduces carbon emissions and returns nutrients to the soil like a mulch.

STEP 2 **Watch the 'Pine Plantation to Paper' ForestVR 360° video (https://forestlearning.edu.au/forestvr/article/4/pineplantation-to-paper.html), then answer the following questions.**

QUESTION 3 What are the source materials used to make cardboard?

Wood from sustainably sourced low quality pine logs and sawmill waste (in the form of wood chips) and recycled cardboard recovered from the community and industry.

QUESTION 4 In your own words or a drawing, summarise the main steps involved in the manufacturing process of cardboard through the pulp and paper mill. You may like to draw a flow diagram or use bullet points.

For a visual cardboard manufacturing graphic example, head here: https://static1.squarespace.com/static/534fe620e4b0337f7ff5c5da/t/611c45aafafbe56db3bdac52/1629242797188/Visy+Paper+Cardboard+Sort+Manufacture+A4.pdf

Use the comment tool options to draw straight onto the pdf or upload an image.

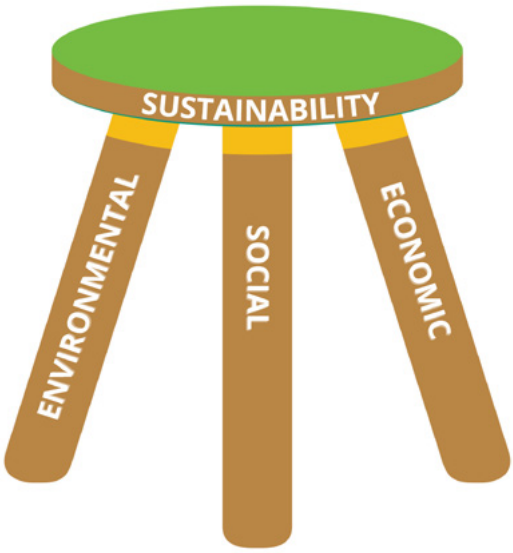
1. Pulp logs enter the chipper.
2. Wood chips are screened by size.
3. Wood chips and recycled paper products are digested with water and chemicals to make wood pulp in the digester.
4. The pulp is sprayed onto a flat screen.
5. This is pressed to remove moisture and dried flat.
6. Dry paper is wound onto jumbo rolls. This is now kraft paper that can be cut to size and wound onto rolls for customer products.
7. The product rolls are stacked and sorted using AGBs (unmanned robots) using barcodes and computers to track products and dispatches.

STEP 3 **As a class, read the information below about the sustainability stool. Discuss the 3 aspects of sustainability and how they can be applied in design and technology. Students then answer the questions below.**

SUSTAINABILITY STOOL

In Design and Technologies, sustainability is about creating designed solutions for preferred futures. It is about solutions that will improve outcomes for people and the environment, that are cost effective, and support fair work and trade.

Sustainability in design rests on three pillars - environmental, social and economic. This is represented in the stool below. A designer needs to consider these pillars when designing new innovations and products.



For example, when in the process of designing products, designers may consider:

- Does my design fill a social need?
- Are the materials I use to produce the product ethically manufactured/sourced?
- Can my designed product be made from environmentally-friendly / responsibly sourced materials?
- Will my designed product materials be accessible?
- How can I design my product so that it can be recycled or reused?
- Is it cost effective to manufacture and distribute?
- Will it create jobs within the local economy?

QUESTION 5 Define what sustainability means in your own words.

Student answers will vary based on the information provided above.

QUESTION 6 In the table below, write which aspect of sustainability you think each statement is most aligned with (multiple aspects of sustainability may apply to some statements).

ENV (Environmental) | S (Social) | EC (Economic)

Table 1. Aspects of sustainability in the cardboard industry.

STATEMENT	ANSWER
Wood fibre can be continually regrown, making it a renewable material.	ENV
Cardboard can be easily recycled.	ENV, S
Cardboard is grown using sustainable forestry practices in Australia.	ENV, S
Cardboard is biodegradable and a good alternative for single-use products.	ENV
Local pulp mills create sustainable local jobs.	S
Cardboard is a cost effective material to produce and recycle.	EC
Cardboard can be flat-packed and transported cheaply before being assembled.	EC

STEP 4 Ask students to compare and discuss their answers with the person next to them.

After a couple of minutes, discuss this as a class. There is no right or wrong answer, just differing perspectives.

STEP 5 Students conduct research into the difference between paperboard (kraft paper) and corrugated cardboard using Table 2 matrix below.

Table 2. Corrugated cardboard and paperboard research activity.

CORRUGATED CARDBOARD		
IMAGES	**PROPERTIES**	**USES**
Find two images showing a product being wrapped in corrugated cardboard and a product packaged in corrugated cardboard.	Include a labeled drawing/image of the structure of corrugated cardboard. ▪ Corrugated cardboard is like a sandwich, it has two flat outer layers and a fluted or wavy inner layer that creates a cushioning effect when absorbing impact. ▪ It is a rigid material and can support heavy objects and stacking. ▪ Its layers mean it is a flexible material when wrapping objects. ▪ The thicker the cardboard layers, the stronger it is.	Find 3 different uses of corrugated cardboard.
PAPERBOARD (SOMETIMES REFERRED TO AS CARDBOARD)		
IMAGES	**PROPERTIES**	**USES**
Find two images that show how paperboard is used in advertising.	Paperboard is a lightweight yet strong material and can easily be cut and formed. Paperboard is usually thicker than paper and more tear-resistant.	Find 3 different uses of paperboard.

Use the comment tool options to draw straight onto the pdf or upload an image.

OPTIONAL EXTENSION

ACTIVITY 3

CARDBOARD AS A PART OF A CIRCULAR ECONOMY

AIM

To understand cardboard as part of a circular economy and use an annotated flow chart to create a circular economy life-cycle for either corrugated cardboard or paperboard, from the sourcing of its material to the end of its life.

30 minutes

individual

STEP 1 Students learn about circular design in circular economies via Stora Enso:

- **Stora Enso website video – Circular design: https://www.storaenso.com/en/sustainability/circular-bioeconomy**
- **Renewable materials into the future made from wood - How we use a tree: https://youtu.be/rUElPYaxgqs**

Remember - something is not recycled until it is made into a new product!

STEP 2 Meeting future resources demand with circular economies.

As a class, consider the following paragraph from the Government of the Netherlands website and discuss any student questions. Students then complete tasks a to c below.

A circular economy can be an important instrument to tackle the current triple planetary crises on climate, biodiversity and pollution. By keeping resources in the loop for longer, we'll avoid emitting greenhouse gases caused by the energy needed to make products.

By 2050 the Dutch economy will run entirely on reusable materials. In this circular economy, there will be no more waste, as resources will be reused again and again.

Source: https://tinyurl.com/4psv32rd

Use the comment tool options to draw straight onto the pdf.

a) **Draw the linear life cycle of a cardboard or timber product familiar to you, from raw material to end of life disposal, using a flow diagram.**

b) **Reimagine how this product might be designed or reused differently in a circular economy, to reduce waste and maximise the use of the wood fibre material it is created from.**

c) **Draw a flow diagram that shows the changes and annotate it to explain where waste is reduced and resource use is maximised.**

TIP: You may wish to use the sample products you brought in earlier as examples that students can use for this exercise, e.g. a cereal box, an egg carton or a corrugated carton.

STEP 3 CLOSING THE LOOP - Where can you contribute to a circular economy?

Paper products in your school

1. Investigate the fate of paper products in your school and if they go to landfill (a linear economy). If no recycling is currently being done, think of ways your school could start to recycle, reuse and reduce paper waste.
2. Investigate the source of paper in the school by checking out the ream of paper's packaging. Is the paper made from recycled paper or virgin copy paper? Does the paper come from a sustainable forest source (that is, does it show a PEFC/Responsible Wood or FSC logo?).

LESSON 2

RESEARCH FOR A CARDBOARD SEAT

120 minutes

For each question, teacher answers are provided on blue.

AIM

To investigate attitudes towards cardboard seats and analyse seat materials and designs.

OUTCOMES

Students will:

- Create and conduct a targeted survey to identify needs and opportunities for cardboard seats.
- Analyse the benefits and disadvantages of three existing seat designs.
- Identify and justify a suitable material for their seat based on their research results.
- Research cardboard seat designs to find inspiration and develop ideas.

MATERIALS

- Computer / devices

TIP: The survey creation and distribution activity and the survey results analysis activity are listed sequentially here in this lesson but will most likely need to take place in different lessons to allow time for surveys to be completed and collated.

ACTIVITY 1 SURVEYS FOR SCHOOL AND HOME

AIM

To develop and conduct market research to find out people's attitudes towards the use of a seat made from reusable cardboard.

30-60 minutes

individual, pairs or small groups

STEP 1 **In pairs or groups, students use either survey A or survey B or create their own survey for a chosen target group.**

STEP 2 **Students use their survey to gather responses from their target group.**

Once the surveys are completed, in the next lesson, students can compile their results and collaboratively share and discuss their findings.

TIP: Students could use a digital survey platform.

EXAMPLE SURVEY ON THE USE OF A CARDBOARD SEAT

SURVEY A: FRIENDS AND FAMILY	NAME:			
QUESTIONS	**ANSWERS (Circle your response)**			
Have you ever sat on a cardboard seat?	Yes	No		
Do you like the idea of using an upcycled seat made from cardboard?	Yes	No	Don't know	
If you own a cardboard seat how often do you use it?	Regularly	Sometimes	Rarely	Never
What appeals to you most about an upcycled seat made from cardboard?	It is a sustainable option.	It is lightweight and easy to store.	It has a modern design aesthetic.	Other:

SURVEY B: SCHOOL PRINCIPAL, SCHOOL STAFF	NAME:			
QUESTIONS	**ANSWERS (Circle your response)**			
Would you consider encouraging students to use upcycled cardboard seats at school events or in areas such as the library?	Yes	No	Don't know	
Why would you consider using cardboard seats at school events or in areas such as the library?	Cardboard seats would be cost effective to use, easy to replace and could be stored flat-packed.	Upcycled seats are better for the environment than seats made from plastic and other materials.	We support sustainable practices at our school .	Other:
Why would you not encourage students to use cardboard seats in your school?	Seats may not last as long and need replacing more often.	They may not be as comfortable.	Seats may be more easily damaged if not handled with care.	Other:

ACTIVITY 2 SURVEY RESULTS

AIM

To analyse survey results to inform the cardboard seat design brief.

30 minutes

individual, pairs or small groups

STEP 1 **In their original survey groups or as a class, students now collate, share and discuss their survey findings.**

STEP 2 **From their results students refine the need for a cardboard seat.**
Questions that may help them to form conclusions include:

QUESTION 1 **From the survey responses, do you think there is a strong need or interest for a seat made from cardboard? Why or why not?**

QUESTION 2 **List any needs for a cardboard seat identified from the surveys.**

QUESTION 3 **Based on the survey results, what things should we keep in mind or what problems or challenges might we encounter?**

QUESTION 4 **Do the survey results mention any desired features?**

ACTIVITY 3 INVESTIGATION OF THE STYLE, FUNCTION AND MATERIAL OF DIFFERENT SEATS

AIM

To investigate what makes a successful seat design by exploring the benefits and disadvantages of different seat materials, functions and styles, as well as features that might meet their targeted user's needs.

30 minutes

individual and small groups

BENEFITS AND DISADVANTAGES OF A SEAT'S STYLE, FUNCTION AND MATERIAL

STEP 1 **Students individually or in small groups, analyse 3 existing seats and explore the benefits and disadvantages of each one in relation to its material, how it functions and its style, using Table 1.**

Image 1 - Metal seat: ***https://classicwithatwist.com.au/products/bistro-metal-chair***
Image 2 - Plastic seat: ***https://tinyurl.com/hydh4d6e***
Image 3 - Cardboard seat: ***https://www.wired.com/2009/02/cardboard-chair/***

Metal Seat

Plastic Chair

Cardboard Seat

Table 1. Three seat benefits and disadvantages comparison of function, style and material.

	WHAT ARE THE BENEFITS OF EACH CHAIR'S FUNCTION, STYLE AND MATERIAL?		
FUNCTION			
STYLE			
MATERIAL			
	WHAT ARE THE DISADVANTAGES OF EACH CHAIR'S FUNCTION, STYLE AND MATERIAL?		
FUNCTION			
STYLE			
MATERIAL			

EXISTING CARDBOARD SEAT DESIGNS

STEP 2 **Students individually research and analyse two existing cardboard seat designs that might meet the needs of their targeted end user, recording their findings in Table 2.**

STEP 3 **Students insert an image of each seat into Table 2 and annotate the features that may appeal to the target group they surveyed.**

Table 2. Existing cardboard seat design research.

CARDBOARD SEAT DESIGN 1	CARDBOARD SEAT DESIGN 2
SOURCE:	**SOURCE:**
APPEALING FEATURES:	**APPEALING FEATURES:**
TARGET END USER:	**TARGET END USER:**
IMAGE:	**IMAGE:**

SUSTAINABLE PROPERTIES OF DIFFERENT MATERIALS

Students investigate the properties of 3 materials, their level of sustainability and if they are suitable for a sustainable seat.

STEP 4 In groups of 4, students play a game where 3 materials, stainless steel, plastic and cardboard, are interviewed for the job of seat material by the designer.

- 1 person plays the designer. Their purpose is to find the best candidate to build their seat with.
- 3 people each play a material candidate. Their purpose is to 'sell' their material properties using the supplied CV (fact sheet) about these qualities.

STEP 5 The interviewer asks each 'material' the questions about their properties listed in column 1 of table 3 and fills in their answers below.

STEP 6 Based on all the answers given, students decide on a sustainability ranking for each material from most sustainable (1) to least sustainable (3) and write it in the results summary.

Table 3. Interview scorecard for the sustainability of material properties for a seat.

Circle and annotate your answers to the following:

PROPERTIES	STAINLESS STEEL	PLASTIC	CARDBOARD
Source	Iron Ore	Fossil Fuels	Wood from trees
Energy used to create the material?	High / Medium / Low	High / Medium / Low	High / Medium / Low
Uses/roles	Aerospace engineering, architecture and construction, and transport/automotive industries for many uses.	Packaging and the toy, medical, automotive, textile, and furniture industry to name a few.	Packaging such as cereal boxes, textiles, fresh food products and online goods, art and craft including picture framing, and more recently furniture and construction.
Renewable?	YES / NO	YES / NO	YES / NO
Explain why or why not?	Non-renewable because it is made from iron ore which is mined from the ground and can not be replenished.	It is made from fossil fuels such as crude oil and these are non-renewable resources.	Renewable because wood fibre comes from sustainably managed trees that are replanted after harvesting.
Biodegradable?	YES / NO	YES / NO	YES / NO
Explain why or why not?	It takes about 1000 years to break down stainless steel but it can be recycled many times at specialist recycling centres.	Most plastics are not biodegradable (can not degrade through natural processes). The most widely used petroleum-based plastics such as polyethylene terephthalate (PET), polyethylene (PE), polypropylene (PP), and polystyrene (PS) are not biodegradable. Bioplastics may be partially to completely biodegradable, containing plant material that composts.	Cardboard is biodegradable and compostable. It is also recyclable if it is not contaminated by food.
Durability comparison	High / Medium / Low	High / Medium / Low	High / Medium / Low
Explain your choice	Stainless steel is very tough, it can withstand weight, heat and moisture for many years.	Plastics are generally tough and corrosion resistant. They will degrade in sunlight.	Cardboard is surprisingly strong but will degrade more quickly than plastic and stainless steel , especially in moisture.
Results summary. Rank each material from 1 - 3, 1 being the most sustainable option for your seat design.			
Ranking:			

MATERIAL 1 - CARDBOARD

PERSONAL INFORMATION

SOURCE: I come from wood harvested from trees.

MANUFACTURE: I am made from mostly low-grade and waste wood that is chipped and pulped then reformed into flat paperboard in a paper mill. I am also made from recycled paper products that are mixed and pulped with wood.

EXPERIENCE

PRODUCT HISTORY / USES: I've had a starring role in packaging since the 1850s, from cereal boxes to textiles to fresh food products, and more recently, delivery of online goods. I have also had roles in the art and craft industry including picture framing and I'm branching out into furniture and construction.

PERSONAL QUALITIES

I am renewable because wood fibre comes from sustainably managed trees that are replanted after harvesting.

I am biodegradable and compostable. I'm also recyclable if I'm not contaminated by food.

I am flexible, lightweight and love to wear advertising and decorative finishes.

I am durable. As packaging I need to survive the rigours of whatever delivery method you throw at me! When I'm corrugated cardboard I have excellent strength due to my fluted layers and do a great job of protecting my contents from damage in transportation. Whilst I am water resistant, I'm not weatherproof and prefer indoor or dry weather jobs.

MATERIAL 2 - PLASTIC

PERSONAL INFORMATION

SOURCE: I can be made from a variety of source materials including crude oil, natural gas, cellulose, coal and salt.

MANUFACTURE: I am energy intensive to create. To begin with, fossil fuels must be refined using high temperatures to isolate the building blocks needed to make plastic, called monomers, such as ethylene and propylene (Plastics Europe, 2022). Inside a reactor using heat, light and enzymes, monomers such as ethylene and propylene are linked into long polymer chains through a process called polymerisation, creating polyethylene and polypropylene ('mono' meaning one, 'poly' meaning many) (Polyplastics, n.d.).

EXPERIENCE

PRODUCT HISTORY / USES:
My modern synthetic plastics were first made in 1906 but bioplastics were made by the Aztecs (1500 BCE) who mixed latex from the rubber tree with plant juice to create different products like sandals and rubber balls used in ceremonious games (Bhanoo, 2010). I've been wildly popular over the past 100 years due to my versatility, with roles in packaging, the medical, textile, automotive, electronic, furniture and toy industries and more.

PERSONAL QUALITIES

For the most part, I am not renewable because fossil fuels such as crude oil, which I am largely made of, are non-renewable materials. However bioplastics that use cellulose monomers from plants are partially renewable.

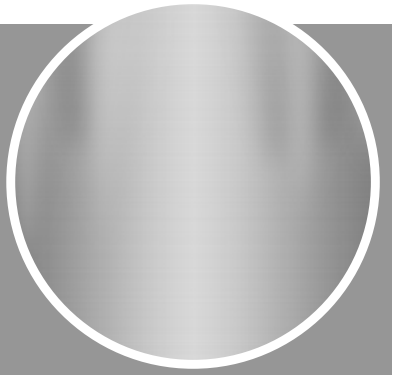
Most of my plastic forms are not biodegradable, including the most widely used petroleum-based plastics such as thermoplastics (plastic bottles, packaging, toys, Teflon, polyester fabric and more). The breakdown of most plastics releases toxins into the environment, however bioplastics are biodegradable and compostable when disposed of correctly (ABA, 2019).

I am very durable, being generally tough and corrosion and chemical resistant. However, I degrade in the sun under UV light, becoming brittle and breaking into smaller pieces after long exposure.

I am easy to make and less expensive compared to metal and I can be coloured and moulded into any shape.

I am flexible, lightweight and love to wear advertising and decorative finishes.

MATERIAL 3 - STAINLESS STEEL



PERSONAL INFORMATION

SOURCE: I come from the ground; steel is made from iron ore rock that is smelted at high temperatures, to isolate the metal from the rock.

DEVELOPMENT: Whilst my steel ancestors have been around since the iron age, stainless steel has only been used for the last 100 years after it was created to stop erosion within gun barrels and prolong their use (BSSA, 2022). I am created within a furnace, where steel is mixed with chromium (and other metals may be added such as manganese and nickel) to form the alloy of stainless steel, which is then cast into moulds and ready to be used to make different products.

EXPERIENCE

PRODUCT HISTORY / USES: I am commonly used in the food and medical industry due to the ease of keeping me clean and sterile. I have been used in aerospace engineering, architecture and construction, and transport/automotive industries for many uses.

PERSONAL QUALITIES

I am not renewable because I come from metals, which are non-renewable resources, however I am 100% recyclable.

I am not biodegradable, I take 100 to 1000 years to break down into organic compounds.

I am highly durable, as I am resistant to corrosion and rust, I'm strong and robust under weight and extreme conditions.

I am lightweight, attractive and require very little maintenance.

I am the most expensive material on offer in this activity.

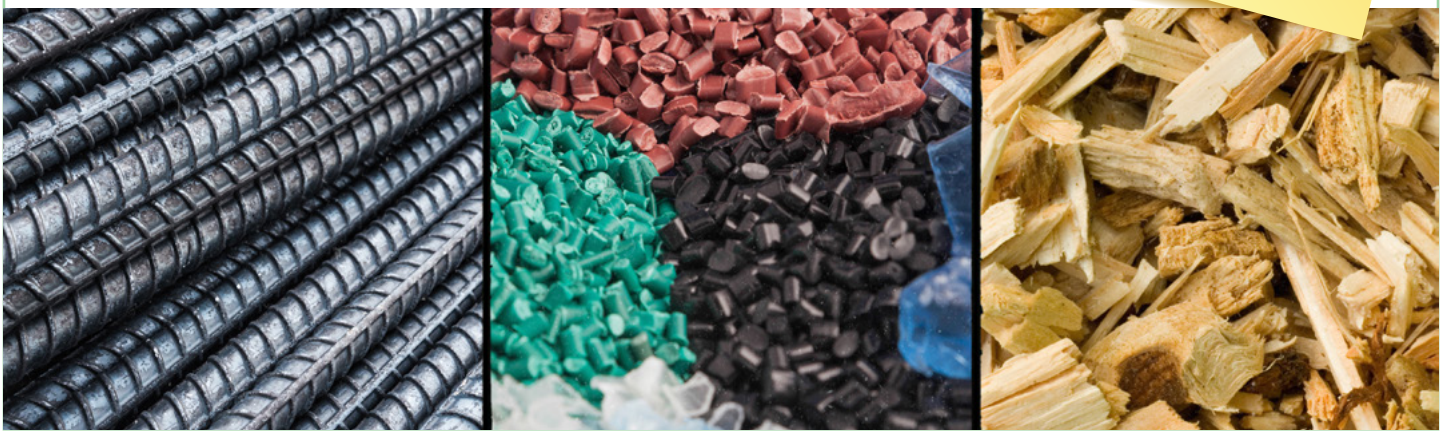
STEP 7 **Students individually select and justify which material they think is best suited to a sustainable seat in their own words by completing** Table 4. My material selection justification**.**

Note: If students didn't select cardboard as their selected material, they can reflect on why cardboard could also be a suitable material choice to produce a seat. Explain that although they could have used other materials, for this class project students will be using cardboard.

Table 4. My material selection justification.

THE MATERIAL I CHOSE AS BEST SUITED TO A SEAT IS:	
JUSTIFICATION I chose this material because...	

TIP: Refer to your results from the materials table and other research.



LESSON 3

DEFINING THE NEED AND GENERATING AN IDEA

120 minutes

For each question, teacher answers are provided on blue.

AIM

To generate a design brief and communicate cardboard seat design ideas.

OUTCOMES

Students will:

- Write a design brief using information gathered from surveys and research.
- Generate ideas that reflect an understanding of the properties of cardboard.
- Create and communicate a final design using annotated sketches and graphical representation techniques.

MATERIALS

- Devices with sketching software.

TEACHER PREPARATION

Teaching tools:

- Cardboard Seat Help Sheet page 39
- Cardboard construction techniques: **https://tinyurl.com/cardboard-construction**
- Research on cardboard seat ideas: **https://www.pinterest.com.au/pin/569916527817417633/?lp=true**

ACTIVITY 1 DESIGN BRIEF

AIM

To write a design brief. A design brief discusses what will be designed and made, as well as how it will meet the need/s of the end user/s.

20 minutes

individual

TIP: Refer to your survey outcomes from lesson 2, to help you respond to these questions.

STEP 1 **Students respond to the questions below to formulate a design brief. They can also refer to the Cardboard Seat Help Sheet below to assist them in their design.**

QUESTION 1 **Who are you designing and creating your upcycled cardboard seat for?**

QUESTION 2 **Why do they need an upcycled cardboard seat and where will it be used?**

QUESTION 3 What materials will the upcycled cardboard seat be made from?

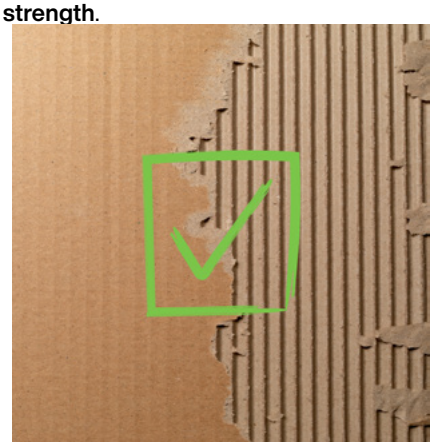
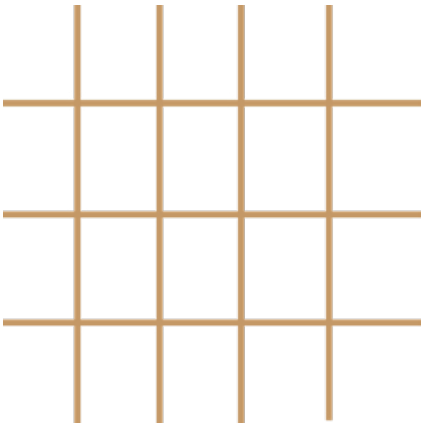
QUESTION 4 What aspects will make it comfortable?

QUESTION 5 How will you make sure it is safe and sturdy?

QUESTION 6 Will it have any additional features?

CARDBOARD CHAIR HELP SHEET

If you are not sure about how to make your chair strong enough, try using the help tips below:

TIP 1	TIP 2	TIP 3
The grain of the cardboard should always run **vertically**, this **increases** the materials **strength**.	**Even weight distribution** prevents the chair from collapsing.	Using "criss-cross", "X" shapes or cylinders will **support more load** than other shapes.
		
		

ACTIVITY 2 GENERATING A CARDBOARD SEAT DESIGN

AIM

To draw two ideas for a cardboard seat that meet the design brief and draw the top view, front view and end view of the preferred idea. A final drawing of the preferred idea will be completed in isometric projection.

100 minutes

individual

STEP 1 **Students generate and sketch 2 seat ideas, guided by their design brief, and annotate the key features of each one, using Table 1.**

Table 1. Annotated seat idea drawings.

SEAT DESIGN #1
SEAT DESIGN #2

STEP 2 **Students choose one seat design and draw its front view, top view and end view using Table 2. This way they can visualise the seat's separate parts in preparation for marking out the material and construction.**

When designing a product, 2-dimensional views are created in an orthographic drawing to record all the information necessary to produce a product, including the top view, front view and end view.

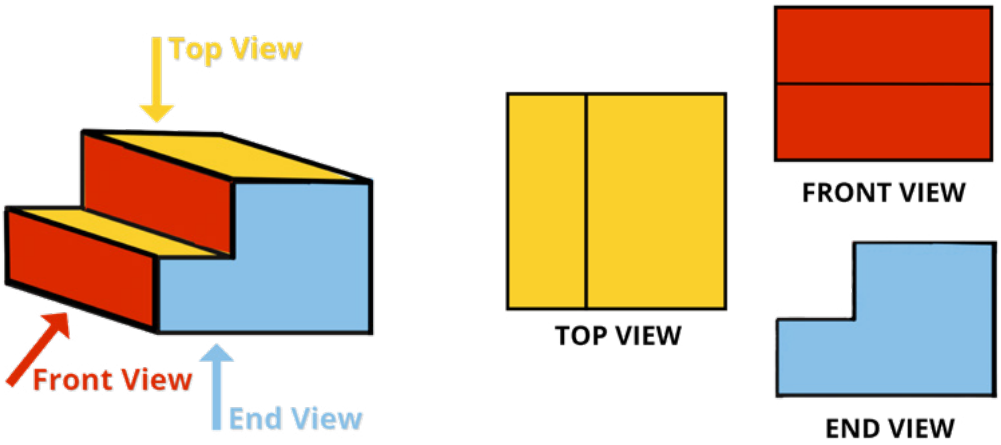


Figure 1. Orthographic drawing.

STEP 3 **Ask students to annotate their drawing and add any additional sketches to answer these four prompts:**

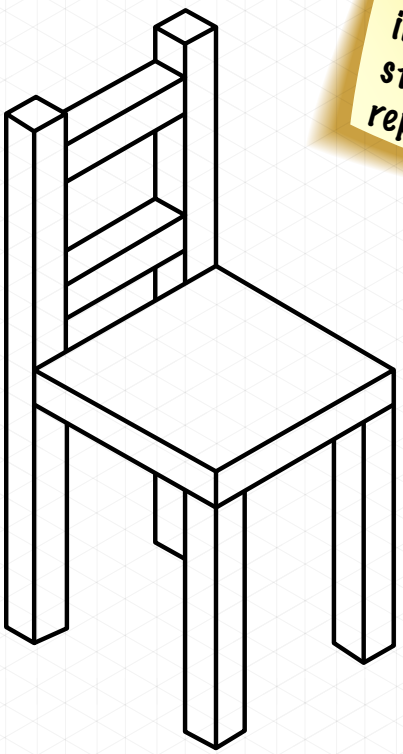
1. **What features (if any) have you added to your seat to meet the user's needs?**
2. **How have you made sure your design will be comfortable?**
3. **How have you made sure your design will be sturdy?**
4. **How is corrugated cardboard a suitable material to use for this seat?**

Table 2. Orthographic projection of my sustainable seat.

FRONT VIEW
TOP VIEW
END VIEW

STEP 4 **Using isometric paper or a computer program, students draw a final idea in isometric view, following the instructions below.**

Table 3. Isometric projection of my sustainable seat.

INSTRUCTIONS	ISOMETRIC PROJECTION
Draw your preferred idea in isometric projection using grid paper or appropriate computer software. Your drawing needs to be at least 10cm x 10cm and include the dimensions of the design. To make sure your dimensions are accurate, measure an existing stool or chair. Colour your idea to show the colour and texture of the cardboard. Annotate your idea by discussing its design in detail. For example: ▪ Does it have 3 or 4 legs? ▪ Does it have a back or arm rests? ▪ Is it stackable? ▪ Have you added any special features?	

TIP: The size of the cardboard seat can be based on an existing seat measured in the classroom, which students modify to represent their idea.

Image source: TES author Mr. Dolphin, 21/3/2022. https://www.tes.com/en-au/teaching-resource/isometric-drawing-chair-12120341

STEP 5 **Teachers guide students to create a list of the materials they will need to produce the cardboard seat. They need to consider how the materials will be sourced, size of the cardboard sheets/ boxes, type of paint they may want to use and any additional materials.**

Table 4. List of Materials needed to produce my cardboard seat.

WHERE WILL MY MATERIALS BE SOURCED?
WHAT SIZE CARDBOARD DO I NEED?
DO I NEED ADDITIONAL MATERIALS E.G. PAINT, FASTENERS, LASER CUTTER, GLUE ETC?

LESSON 4

RISK ASSESSMENT AND PRODUCTION OF A PROTOTYPE

For each question, teacher answers are provided on blue.

120 minutes

AIM

To complete a risk assessment and identify safe work practices and equipment; to create a prototype and develop skills in working with cardboard.

OUTCOMES

Students will:

- Select suitable materials and equipment to make a cardboard seat.
- Measure and mark out cardboard to make a prototype.
- Join cardboard using hot glue and slots.
- Identify and apply safe work procedures.

MATERIALS

- A projection screen for whole class to review the **production sequence.**
- Whiteboard or smartboard to complete the **risk assessment** as a class.

For prototype building

- Cardboard from school or home
- Hot glue gun
- A ruler
- Pencil
- Scissors
- Cutting knife
- Cutting mat
- Risk Assessment forms
- Safety equipment - glasses and an apron

TEACHER PREPARATION

Teachers can create an example seat and/or small prototype samples, which students can use to help them build their own seats.

The production sequence is a guide/example that you may like to use or adjust to your own style, or apply your own production sequence.

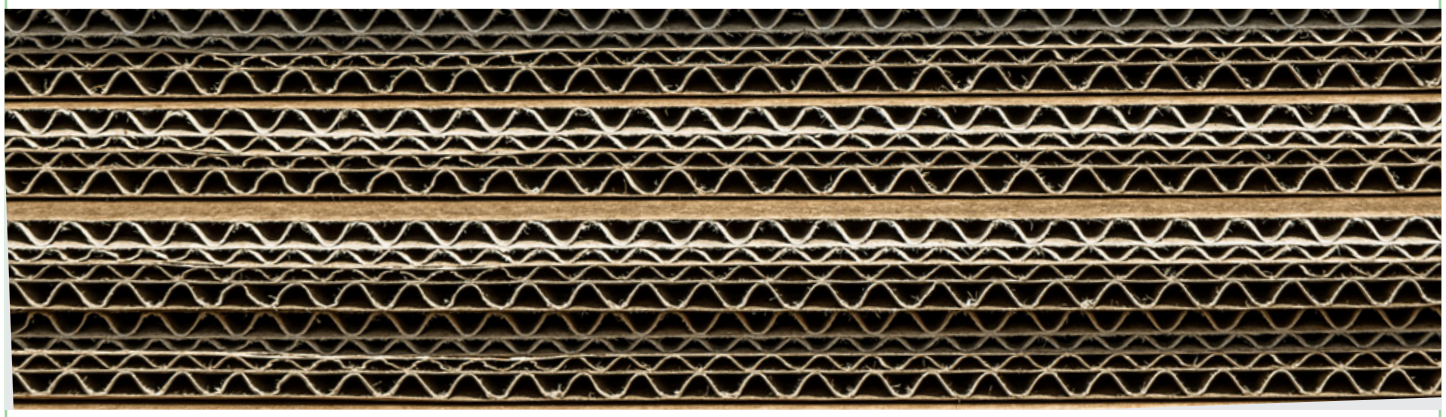


Photo by Roberto Sorin on Unsplash

ACTIVITY 1 REVIEW OF CARDBOARD

AIM

To provide a brief recap of cardboard, recalling previous lessons where students learnt about the properties and uses of cardboard, where it comes from and how it is suitable for their seat.

20 minutes

individual and whole class

STEP 1 **Students fill in Table 1 on the next page, either individually or in pairs.**

STEP 2 **Students share their summative ideas through class discussion. The teacher can summarise key points made by students and the benefits of living more sustainably if cardboard products are used.**

Table 1. Review of the properties of cardboard.

MATERIAL PROPERTIES	CARDBOARD
Source	Cardboard is sourced from woody trees, mostly low grade logs and waste generated in timber harvesting as well as waste wood from the timber processing industry.
How was it created?	Wood is chipped and pulped then reformed into flat paperboard in a paper mill.
What is it used for?	Cardboard is primarily used for packaging but also furniture, construction and a whole host of emerging products.
Renewable	YES or NO
How is it or is it not renewable?	Cardboard is made from wood fibre grown on trees that are harvested and replanted to provide a continual and ongoing supply.
Biodegradable	YES or NO
How is it or is it not biodegradable?	Cardboard is made from wood fibres that break down under wet, warm conditions in soil due to microbes and insects (e.g. termites) which consume it.
Carbon emissions in manufacturing	LOW or HIGH
Why are the emissions low/high?	Cardboard does not require high temperatures to extract the raw materials or form the end material; it captures and stores carbon dioxide as a wood product made from living trees.
Durability	LOW or HIGH
Why is its durability low/high?	Cardboard is a durable material when used correctly, however it can have a shorter life cycle than some materials and is not suited to prolonged outdoor use/storage.
Results summary	What do your results tell you about the material's properties, and its suitability as a seat?
	Cardboard is a suitable material for a seat so long as it is not used/stored in weather where it may get heavily wet. It is a sustainable material that is light-weight, can be decorated and aesthetically pleasing, as well as recyclable, renewable and biodegradable at the end of its life as a seat.

ACTIVITY 2 RISK ASSESSMENT

AIM

Students complete a risk assessment to apply safe procedures whilst producing their upcycled cardboard seat.

30 minutes

whole class

STEP 1 **Introduce the production sequence (see lessons 5 - 7, page 32).**

STEP 2 **Carry out a class risk-assessment on the whiteboard or smartboard. Students take notes in their workbook.**

Table 1. Risk assessment.

EQUIPMENT	WHAT INJURIES MIGHT OCCUR?	HOW MIGHT YOU PREVENT THIS INJURY/S FROM HAPPENING?
Scissors		
Hot Glue Gun		
Cutting Knife		

STEP 3 **As a class, students create a list of safe working practices that are to be followed. These can be put up within the room somewhere as a safety checklist.**

Examples of safe working practices:

- Always wear safety glasses/ goggles when using a hot glue gun.
- Use the hot glue gun in work areas that are clean and dry.
- Use a wire or metal safety stand to hold the hot glue gun when not in use.
- Do not touch the end of the gun when it is in use.
- Have something under the hot glue gun to catch excess glue.
- Use a steel ruler when cutting straight lines with a cutting knife.

TIP: This is a basic risk assessment matrix. Add or change this assessment as required for your own school policies and procedures.

ACTIVITY 3 BUILDING PROTOTYPES

AIM

To build two or three small prototypes to develop skills and explore different ways to fold and join cardboard, in preparation for building seat designs.

70 minutes

individual

STEP 1 **Students follow the production sequence and safe work practices to create 2-3 prototypes of cardboard seats. To develop skills, they follow the tips in appendix 1.**

Refer to the summarised production tips in Appendix 1 and for more detail see the fundamentals of cardboard in this PDF: https://cdn-learn.adafruit.com/downloads/pdf/cardboard-fundamentals.pdf

STEP 2 **Students draw or paste images of their prototypes in the space provided, annotated with any construction notes they find useful. Students then write a summary of what worked well and what didn't during the building of their prototypes in the space provided. This may help them to think through any adjustment they need to make for building their final design.**

LESSONS 5-7

CARDBOARD SEAT PRODUCTION

120 minutes x3

For each question, teacher answers are provided on blue.

AIM

To produce a cardboard seat that meets the needs outlined in the design brief.

OUTCOMES

Students will:

- Follow a production sequence to produce their final seat, using their time effectively.
- Develop spatial skills and building techniques working with cardboard.
- Apply safe work procedures.

MATERIALS

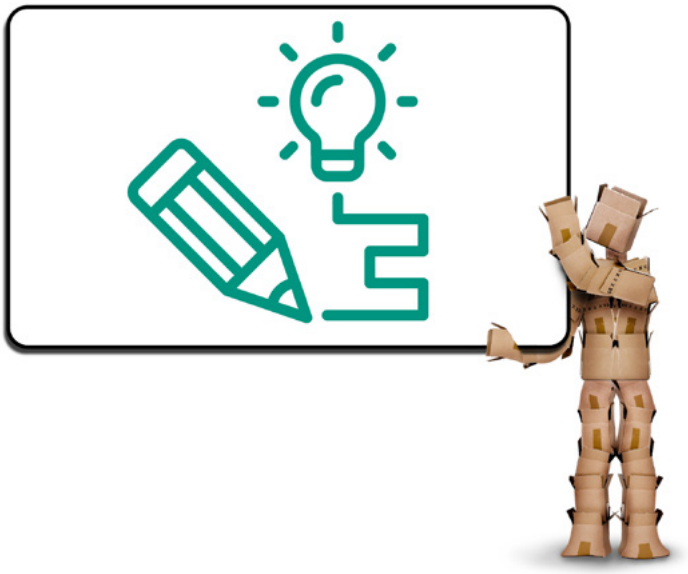
- Student design ideas and prototypes
- Cardboard from school or home
- Hot glue gun
- A ruler
- Pencil
- Scissors
- Cutting knife
- Cutting mat
- Risk Assessment forms
- Safety equipment - safety glasses and an apron.

TEACHER BACKGROUND INFORMATION

Video about producing a cardboard seat:
https://youtu.be/fOkA1uime_Y

Video on strengthening cardboard joins:
https://youtu.be/HRmJ7yD3ZnE

Cardboard construction techniques, tools for the classroom:
https://tinyurl.com/cardboard-construction



STEP 1 **Students follow the sequence of production and use the skills they obtained from building prototypes to produce their own upcycled cardboard seat for their end user.**

PRODUCTION SEQUENCE

1

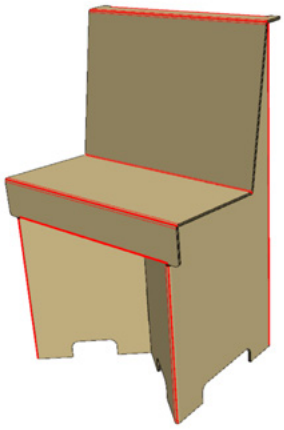
Gather the materials and tools you will need:

- Your design idea
- Your prototype
- Safety glasses
- An apron
- A cutting mat
- Steel ruler
- Pencil
- Scissors
- A hot-glue gun
- Other _____

_____

Continually refer to the class risk assessment to make sure you work though each production step safely.

2 Measure and mark out the parts of your seat onto your cardboard with a pencil. Make sure you have measured twice before you cut out your pieces.



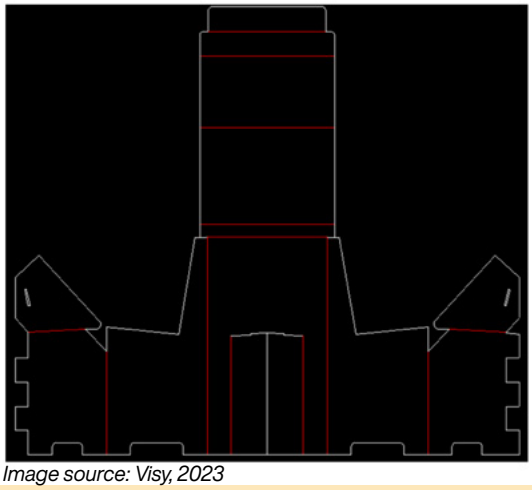


Image source: Visy, 2023

3 Cut out your cardboard pieces.

4 Either glue or cut out slots to join the different parts of your cardboard seat.

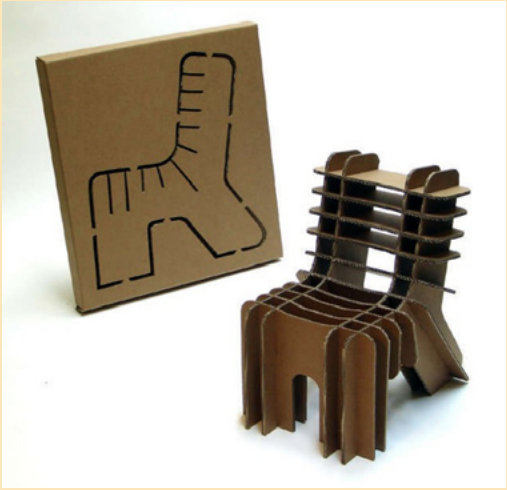


Image source: © 2022 SlideShare from Scribd

5 Continue to check your seat at each stage of the production process and make any adjustments as needed.

Remember your seat needs to be sturdy and comfortable.

LESSON 8

EVALUATION AND PRESENTATION OF FINISHED UPCYCLED CARDBOARD SEAT

For each question, teacher answers are provided on blue.

120 minutes

AIM

For students to evaluate their materials selection, design process and production outcomes, summarise their knowledge and skills and gather feedback on their finished product.

OUTCOMES

Students will:

- Complete an evalutaion of their final cardboard seat product.
- Develop communication and presentation skills through presenting their final product to an audience.
- Provide constructive written feedback to peers following class presentations.

MATERIALS

- Evaluation worksheet
- Design brief
- Feedback form
- Final idea
- Finished cardboard seat

TEACHER INSTRUCTIONS

Teachers can choose to:

- invite selected students to present and discuss their work in front of the class and obtain feedback

OR

- have students discuss their products and obtain feedback in smaller groups

OR

- showcase final ideas and end products at assembly or a school event.

TIP: This evaluation could be used as a part of formative assessment for the unit.

ACTIVITY 1 EVALUATION

AIM

For students to evaluate design ideas, processes, solutions and outcomes.

30 minutes

individual

STEP 1 **Students complete the evaluation worksheet to summarise and reflect on what they have learnt.**

TIP: This lesson may provide assessment opportunities.

EVALUATION WORKSHEET

PASTE AN IMAGE OF YOUR COMPLETED CARDBOARD SEAT HERE

Respond to the following questions and try to elaborate on what you have learned throughout the lessons. Use phrases such as:

- 'I used to think . . . now I think. . .'
- 'At first, I didn't understand . . . and now I do because . . .'

QUESTION 1 Who did you create a cardboard seat for?

To respond to this questions students can refer to their survey, design brief and investigation.

QUESTION 2 How did you adapt your design to make it appeal to them?

To respond to this question, students should refer to their generation of ideas.

QUESTION 3 What were the benefits of measuring an existing seat or chair?

To respond to this question students need to think about ergonomics and anthropometrics.

QUESTION 4 What worked well during production?

To respond to this question students need to think about measuring and marking out, sourcing of materials, joining methods and use of equipment.

QUESTION 5 What did you find difficult?

To respond to this question, students need to think about the design process they followed, researching, generating ideas, producing and evaluating.

QUESTION 6 Why was cardboard a good material to use?

Students need to think about its ease of use, such as its malleability, flexibility, rigidity and ease of joining.

QUESTION 7 How will your product help the planet?

Students need to refer back to their research on the material.

OPTIONAL EXTENSION

ACTIVITY 2 CLASS SHOWCASE

AIM

For students to present their finished upcycled cardboard seats to the class or in small groups to develop communication and presentation skills.

90 minutes

whole class/small groups

STEP 1 **With the whole class, discuss how to give constructive feedback, including what is appropriate and useful.**

STEP 2 **Students present their completed cardboard seat with their final design to the class/small group and ask students to complete a short feedback form.**

Teachers/students can use the example forms below or create their own.

FEEDBACK FORM	
FUNCTION Does the cardboard seat function as intended, is it sturdy and comfortable? Why or why not?	
TECHNOLOGY Do you think the cardboard seat will last with heavy use? Why or why not?	
STYLE (HOW IT LOOKS) Does the style of the cardboard seat reflect the end user's requirements? Why or why not?	

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DESIGN AND TECHNOLOGIES YEAR 7 & 8 LESSONS

PRODUCTION

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Forest Learning – **https://forestlearning.edu.au/**

SOFTWARE

ForestVR™ apps (IOS, Android, Oculus Go) available via **https://www.forestlearning.edu.au/forestvr.html**

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CURRICULUM LINKS

VICTORIAN CURRICULUM LINKS		
Strand	**YEAR 7 & 8 CONTENT DESCRIPTIONS**	**LESSONS**
Technologies and Society	Examine and prioritise competing factors including social, ethical, economic and sustainability considerations in the development of technologies and designed solutions to meet community needs for preferred futures. (VCDSTS043)	1, 2
	Investigate the ways in which designed solutions evolve locally, nationally, regionally and globally through the creativity, innovation and enterprise of individuals and groups. (VCDSTS044)	1
Technologies Contexts	Analyse ways to create designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment. (VCDSTC048)	2, 3
Creating Designed Solutions	Investigating Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas. (VCDSCD049)	2, 3, 4
	Generating Generate, develop and test design ideas, plans and processes using appropriate technical terms and technologies including graphical representation techniques. (VCDSCD050)	3, 4
	Producing Effectively and safely use a broad range of materials, components, tools, equipment and techniques to produce designed solutions. (VCDSCD051)	4, 5, 6, 7
	Evaluating Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability. (VCDSCD052)	3, 8
	Planning and managing Use project management processes to coordinate production of designed solutions. (VCDSCD053)	5, 6, 7

APPENDIX 1

PRODUCTION TIPS

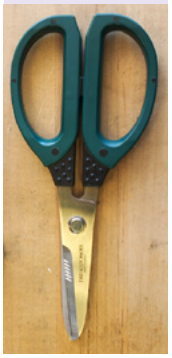
This information has been summarised from the following website: **https://learn.adafruit.com/cardboard-fundamentals/cutting-tools-and-techniques** and PDF by John Park, 2021, Adafruit Industries.

Steel rule for marking out and cutting straight lines.

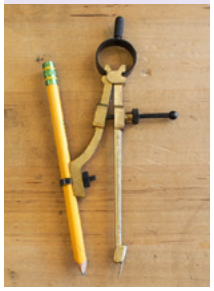
Pencil and texter for marking out on your cardboard.

Retractable cutting knife/ utility knife for cutting your cardboard - straight long cuts.

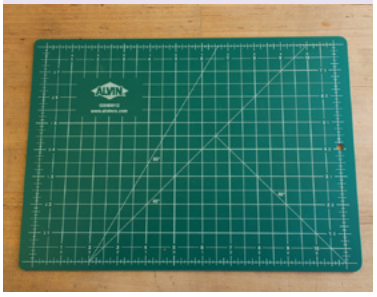
Hobby knife for cutting your cardboard - detailed curved cuts.



Scissors for cutting your cardboard.



Drawing compass to draw circles and rounded corners.



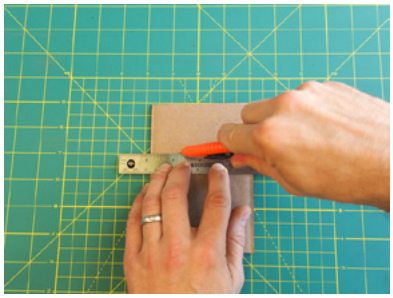
Cutting mat to protect the table surface from scratches and cuts from the cutting blades.

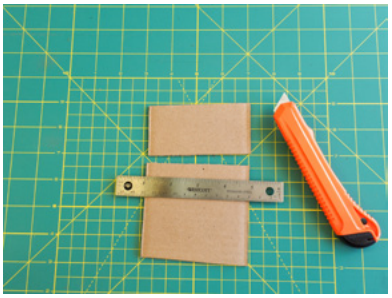
HOW TO CUT CARDBOARD

STRAIGHT CUTS

Here, a small straight edged metal ruler is used with a hobby knife to make a nice, straight cut.

- Keep those fingers out of the way
- Apply firm pressure to the ruler
- Cut away from yourself, not toward your body

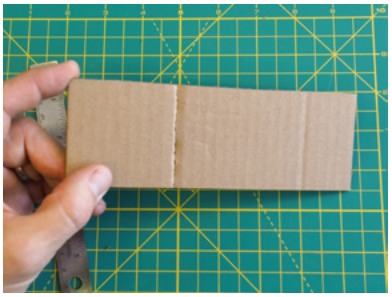




HOW TO BEND CARDBOARD

CREASE TO BEND

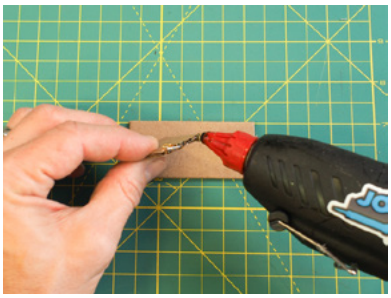
Run a creasing tool across the cardboard a few times in order to create a better bend.

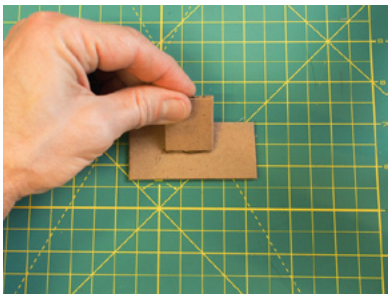


HOW TO JOIN CARDBOARD

HOT MELT GLUE

Hot melt glue is one of the best ways to join cardboard. It is fast to cure, strong, and can fill in gaps in uneven surfaces.





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