

# Industry Brief: Teachers: MakerSpace: Caroline Keep

Research included:

<https://www.theguardian.com/lifeandstyle/2015/apr/30/fda-clinical-trials-gender-gap-epa-nih-institute-of-medicine-cardiovascular-disease>

<https://www.theguardian.com/lifeandstyle/2019/feb/23/truth-world-built-for-men-car-crashes>

<https://www.theguardian.com/science/2019/jul/28/medical-bias-against-women-drug-trials-cpr-medicine-gender-inequalities>

Filmed Tuesday 24th September 2019 at [TNT Conference](#)

## Introduction

Historically, medical devices have been designed with a template that is for men only. With women's hands and limbs being anatomically different than men, this can affect their use and cause major injuries and health issues for women. This project is for students to design their own 3d printed cast or brace. Enabling more young people worldwide to engage with 3d design and create devices that can improve society.

A key outcomes for students is to use the ASSESSFM method of designing a project which will be used within the workbook whilst designing a brace. The workbook included in this document lists key outcomes at each session to achieve this task.

## Information for Teachers

We would allow 4-6 hours for the following activities.

This can be broken down into five separate hours (across a school term or in separate lessons) or to be completed over a school day:

**0-1 hour:** Watch industry brief from Caroline Keep. Planning and researching typical 3d printed casts for broken bones.

**1-2 hour:** Decision on which area of the human body to concentrate on and researching the biology. Giving out project roles -researcher, designers, ergonomics, recorder, team leader. Student can paper mache one of their own hands.

**3-4 hours:** Designing product using allocated roles.

**4-5+ hours:** Designing/ Constructing product & presenting work as a team.

## Resources

- Access to the worksheets below (online or printed).
- Access to videos: Industry Brief with Caroline Keep.
- Access to Worksheets for guidance for design (printed or electronic).
- Access to PC – CAD software Autodesk, Sketch Up, TinkerCad.
- 3d printer, although files can be sent.

## **Key Learning Outcomes and Skills**

### **Knowledge**

Demonstrates knowledge of the design process in principle (e.g. can explain in their own words).

### **Understanding**

Demonstrates understanding of the design process and using a criteria in action as well as in principle (e.g. can explain what the potential consequences might be). Clearly defines key terms.

### **Analysing**

Can identify the design principles involved in particular product (e.g. after researching it and/or discussing it, can 'spot' what the issues are and apply the design criteria in context).

### **Critical Thinking**

Selecting relevant criteria and elements to design a product, and present the possible outcomes (successes and risks)

### **Evidence**

Uses relevant case studies, research and examples (e.g. references to existing products, design criteria and previous case studies) to support their arguments and justify their conclusions.

### **Presentation**

Produces well conceived thought processes - , with logically ordered elements clearly separated out either in image, word or verbally. Accurate spelling and grammar where appropriate.

### **Evaluation**

Demonstrates the ability to summarize the main design points, 'weigh-up' arguments based on their strength or importance in balance with each other, and reach a clear conclusion.

## MakerSpace Activity Description and Notes for Teachers

- Use paper pattern modelled of the area of the hand or paper machine model. Students will need to measure this!
- Design the shape in either Tinkercad/sketch up/Autodesk or on the software you like/have and design a solid form.

### Advice For Students

You might find the following of use to you:

If you struggle to print in a wrist shape then:

- Print the design flat in PLA only and with solid infill (100% fill in [Cura Software](#) available on [Ultimaker](#) free ).
- Place the 3D-print into hot water, make sure you (as the teacher) does this - taking care to not burn yourself!
- Remove the design after a few minutes with tweezers.
- The design will still be hot, but you can mold it to the cast you have designed or to a hand (which you can cover with material to protect the wrist). **Only let a teacher do this.** Please do this carefully not attaching to wrist when too hot, the design should be warm!!
- Using your hand to mold the support and allow to cool down in the *shape desired*. Continue to do this until you have the shape you need.

**Teachers: Ensure that a Health and Safety / Risk Assessments are secured in advance of this work.**

## Introductory activity

Historically, medical devices have been designed with a template that is for men only. With women's hands and limbs being anatomically different than men, this can affect their use and cause major injuries and health issues for women.

Women are shorter, about 9% on average.

Link: [https://en.wikipedia.org/wiki/Average\\_human\\_height\\_by\\_country](https://en.wikipedia.org/wiki/Average_human_height_by_country)

Males bones tend to be bigger than female bones

Link:

<https://opentextbc.ca/anatomyandphysiology/chapter/6-6-exercise-nutrition-hormones-and-bone-tissue/#fs-id1303451>

Women are much more likely to develop [osteoporosis](#), which is a health condition that weakens bones, making them fragile and more likely to break.

Osteoporosis affects over 3 million people in the UK and there are more than 300,000 fractures every year due to osteoporosis. For women, the hormone oestrogen helps protect bone strength. The reduction in oestrogen in the years following [menopause](#) causes a rapid bone loss, which can lead to osteoporosis. About 1 in 2 women and 1 in 5 men over 50 will break a bone because of osteoporosis, so it is important to keep your bones healthy.

<https://opentextbc.ca/anatomyandphysiology/chapter/6-6-exercise-nutrition-hormones-and-bone-tissue/#fs-id1303451>

However, most medical devices and medical research is based on the male anatomy.

Link:

<https://www.theguardian.com/lifeandstyle/2015/apr/30/fda-clinical-trials-gender-gap-epa-nih-institute-of-medicine-cardiovascular-disease>

So today I'm challenging you to design a brace/cast for female use.

3d printing has great advantages and is one of the most important skills in industry right now as a key area for industry 4.0 creative jobs.

You probably know someone who has broken bones at some point and the discomfort of a traditional brace or cast being made from unbreathable material. It can lead to itchininess and skin infections, as well as not being great when you want to get into a bath!

3d printed cast can, however, be made to be breathable.

Using a pattern to create gaps in the design, you can make breathable supports, they are waterproof and can aid in the treatment of the broken or sprained wrists - as you can assess the area. In fact recently, a study was shown 3d printed cast can make your broken bones heal much faster up to 40.

Link: <https://themerke.com/3d-printed-cast-heals-bones-much-faster/>

**With 3d printing allowing us to make things more personalised, I'm challenging you to design a cast that is accessible for everyone**

**3d printing is one of the leading key areas of industrial growth and will play a main role in manufacturing in the future.**

**However, it's use in medicine is just beginning to be explored. Using your creative design workbook, research the types of medical casts/braces that are currently in use.**

Showcasing 3d printing (TedEd short clip):

Link: <https://ed.ted.com/on/Zi2x6gph>

**Your task is:**

- Gain and understanding of the design brief form the clip
- Develop skills in researching information
- Develop skills in formulating a simple design brief.

- Use research and exploration to investigate different designs and cultures
- Investigate new and emerging technologies

### **Using A Design Criteria to Assess and Evaluate Ideas**

When planning a product having a plan for how the design team will work and how the product fits into the current market is essential.

In this activity, you will use an industry method for assessment of your research results and assign team roles.

#### **Your task is to:**

- Use ASSESFM to assess and evaluate the work of past and present professionals
- Develop team working skills by peer assessing ideas and identifying the final design for the group.

### **Design Development**

Now you have your design project planned today you start your individual roles.

#### **Your task is to:**

- Utilise the design criteria set by the specification when producing ideas.
- Develop team working skills by peer assessing ideas and identifying the final design for the group.
- Develop and design ideas using annotated sketches using

### **Finalising the Industry Brief**

Final design stage can be the most difficult and now your start to bring your results together. You can also start to print your brace if you need help with accessing a 3d printing, please contact <https://www.createeducation.com/> to access a FREE printer for your school.



If you find your running behind now is the time to pull together as a team and finalize your product brief.

**Your task is to:**

- Continue construction of the model
- Reflect on the process of design and presentation

**Evaluation your Product and Presentation**

Reflection on your final product together as a team is *how we improve* any design.

In this activity time, please practice your presentation and get ready to talk about your brace/cast as a team.

**Your task is to:**

- Develop modelling skills by completing the final model.
- Develop presentation skills by presenting final proposal to the class.
- Develop skills in peer assessment by providing feedback to others.
- Evaluate your work.

## Intelligence

- <https://academy.autodesk.com/>
- <https://pratt.duke.edu/about/news/better-brace>
- <https://www.nhs.uk/conditions/osteoporosis/>
- [https://www.amazon.co.uk/dp/B07CQ2NZG6/ref=dp-kindle-redirect?\\_encoding=UTF8&btkr=1](https://www.amazon.co.uk/dp/B07CQ2NZG6/ref=dp-kindle-redirect?_encoding=UTF8&btkr=1)

## Useful Resources: Teachers

FOR USE IF YOU ARE THERMOFORMING:

<https://www.instructables.com/id/Thermoforming-3D-Printed-PLA-for-Use-in-Prosthetic/>

Design guidance

- <https://www.createeducation.com/>
- <https://academy.autodesk.com/>
- <https://www.tinkercad.com/>
- <https://ultimaker.com/en/resources/21890-lesson-ideas-and-starters>
- <https://www.instructables.com/id/How-to-Design-Custom-3D-Printable-Braces-for-Arm-I/>

# Industry Brief: MakerSpace Booklet

This booklet will help you assess your ability to work towards a designing a 3d printed cast/brace. You will work as a team and your final presentation will be given feedback by your teacher and class. The lessons will run over approximately 5 hours.

## **1: Research and exploration to understand design process and understanding of the design brief**

- Develop skills in researching information.
- Develop skills in formulating a simple design brief.
- Use research and exploration to investigate different designs and cultures. Investigate new and emerging technologies.

## **2: Using ASSESSFM to evaluate others work**

- Use ASSESSFM to assess and evaluate the work of past and present professionals.
- Develop team working skills by peer assessing ideas and identifying the final design for the group.

## **3: Developing and modelling a design idea**

- Utilise the design criteria set by the specification when producing ideas.
- Develop team working skills by peer assessing ideas and identifying the final design for the group.
- Develop and design ideas using annotated sketches using CAD.

## **4: Making, sketching or modelling out a quality product**

- Continue construction of the model.
- Reflect on the process of design and presentation.

## **5: Evaluation and presentation of model.**

- Develop modelling skills by completing the final model
- Develop presentation skills by presenting final proposal to the class. Develop skills in peer assessment by providing feedback to others. Evaluate your work

# Analysis

Using either **digital software** for example Coggle or on this page, please create a **Mind Map** containing information regarding braces/casts.

## Things to include:

- What is a brace/cast defined as ?
- Types of braces/casts
- Advantages/disadvantages
- How are braces/cast used today ?

# Existing Types of Braces/Casts

**Note your research below (images or words) on existing braces / casts.**

# Using ACCESS FM to Assess a Brace/Cast

**On the following pages, please decide on your cast/brace and use the following method to write a paragraph as a team.**

**IDEA:** If you need an example, try this industry link: <https://activarmor.com/>

## **AESTHETICS**

*What does this brace/cast look like? Think about the shape? Attractive or ugly and why? Does it use colour, textures or patterns? Does it include text or signposting? How is it advertised in images?*

## **COST**

*How much do you think it cost to produce? Is it value for money? CLIENT Who is the brace/cast designed for? How and where would they use it? Does it improve the clients life? How is it promoted to the client?*

## **ENVIRONMENT**

*Is the brace/cast environmental friendly? Does the brace/cast use recycled materials or reusable parts?*

## **SAFETY**

*Is the product safe? Does the brace/cast have any sharp edges? How did the designers think about safety when designing the brace/cast?*

## **SIZE**

*What size is the brace/cast? Why has it been designed this size?*

## **FUNCTION**

*What is the brace/cast's job? Why has it been designed this way to perform that job? Could it be improved for the task?*

## **MATERIALS**

*What materials is the brace/cast made of? Are the materials suitable? Would other materials be more suitable? What impact could the designers choice of material affect the environment?*

### Using ACCESS FM on a brace or cast

Aesthetics	
Cost	
Client	
Environment	
Safety	
Size	
Function	
Material	

# Design Specification

**Using your research design your cast here. Draw it out below.**

**Please annotate your ideas with the following information:**

- What materials, and colour will you use?
- Will you design it in paper mâché or draw it out in cut out?
- What adaptations have you made to fit all groups?



# Progress Report

Student Feedback	Teacher Feedback
WWW. Our project is good so far because ....	
EBI—We could improve it by,...	
What we need to do next is ...	
This didn't go to plan...	

# Building our Brace or Cast

**Include here thoughts or observations on how you built your brace/cast.**

**IDEA:** Try to include diagrams, pictures and annotations.

# Final proposal

Here is where you show pictures, diagrams, notes and observations on your final brace or cast.

# Evaluation

**My team worked well because ...**

**Write down all the processes and skills you have learnt in this project.**

**What could have been improved?**

**What is the best thing about your brace/cast?**

