

Industry Brief: Students: MakerSpace: Caroline Keep

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

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 are 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 itchiness and skin infections, as well as not being great when you want to get into a bath!

A 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, a recent study showed that a 3d printed cast can make your broken bones heal much faster.

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 the uses of 3d printing in this TedEd short clip:

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

Your task is:

- Gain an understanding of the design brief from 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 ASSEFSM 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.

Finalising the Industry Brief

Final design stage can be the most difficult and now you start to bring your results together.

In this activity time, please practice your presentation and get ready to talk about your brace/cast as a team. You may also construct the product as part of this activity.

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.

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

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 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** [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?

MakerSpace Construction Guide

- 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 and design a solid form.

Advice For Students

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 your teacher does this - taking care to not burn themselves!
- 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.

IDEA: Create a hardcopy or online scrapbook or journal to illustrate this process. Consider how you could use this as an instruction guide for other students in your school - or share as part of this project.

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?

