

name:

teacher/class:

Introduction

Humans have a huge impact on the environment - we build towns and cities, mine for metals, cut down trees and dig for oil - and all of this has a negative impact on the planet and wildlife. Designers and engineers are increasingly aware of the damage people are doing and are researching ways to make things more *sustainable*.

Can you think of product or service that humans use, but has a negative impact on the environment? Can you think of a way the product or service could be changed so that it caused less damage to the environment?
Present your research and your idea for a solution.

What you are going to learn...

You will learn about the following topics in this project.

- ☐ The difference between hardwood and softwood.
- ☐ Features of felled wood.
- ☐ Sustainability of wood.
- ☐ Flaws in natural wood.
- ☐ How to read technical drawings.
- ☐ How to measure and mark accurately.
- ☐ Safety in a workshop or maker-space.
- ☐ The names and functions of a range of hand and machine tools.
- ☐ How to prepare wood for a finish.
- ☐ How to apply a finish to a wooden product.
- ☐ How to plan for manufacture.
- ☐ How to make something from wood!

How you will be assessed...

You will be assessed in a number of ways throughout this project.

- ☐ Your answers in this booklet.
- ☐ Your accuracy with measuring and marking.
- ☐ Your accuracy with cutting and shaping wood.
- ☐ Your safety and conduct in a workshop or maker-space.
- ☐ Your tool recognition.
- ☐ The quality of your final model.
- ☐ Your home-learning tasks.
- ☐ Your understanding of sustainability.
- ☐ Your learning about materials.
- ☐ Your unit exam.

Making things can be great fun - and you learn a lot by using your hands
Describe any project that you have made before - from woodwork to Lego - let us know!

Let's all be tree huggers...



Hardwood

Hardwoods are sourced from broad-leaved trees, that are typically 'deciduous', meaning they loose their leaves in Autumn. Normally, they grow **slower** and are **thicker** than softwoods. Although they are not necessarily 'harder'; Balsa is a hardwood species that is soft enough to chew! Hardwoods grow in warmer climates and tropical forests. Hardwoods are typically **more expensive** and more desirable for quality furniture.



Softwood

Softwoods are sourced from trees that have narrow, cone-shaped leaves. Most softwoods are described as 'coniferous' and are 'evergreen', meaning they do not shed their leaves in Autumn. Softwoods tend to be **faster** growing than hardwoods - but don't think they are soft - many species are actually stronger than hardwoods and are used in building construction. Softwoods tend to be **less expensive** and are generally more **sustainable** as they grow quickly.

Wood you like to know?

There are over 60,000 species of tree on the planet. We don't expect to learn them all!

However, designers and engineers do need to know about a range of woods. Some commonly used species are shown below.

Research and identify whether they are HARDWOOD or SOFTWOODS.



Pine

_____



Ash

_____



Douglas Fir

_____



Meranti

_____



Tulip

_____

Trees are a great source of useful material for humans.
Describe two other benefits trees provide our planet and the environment.

_____

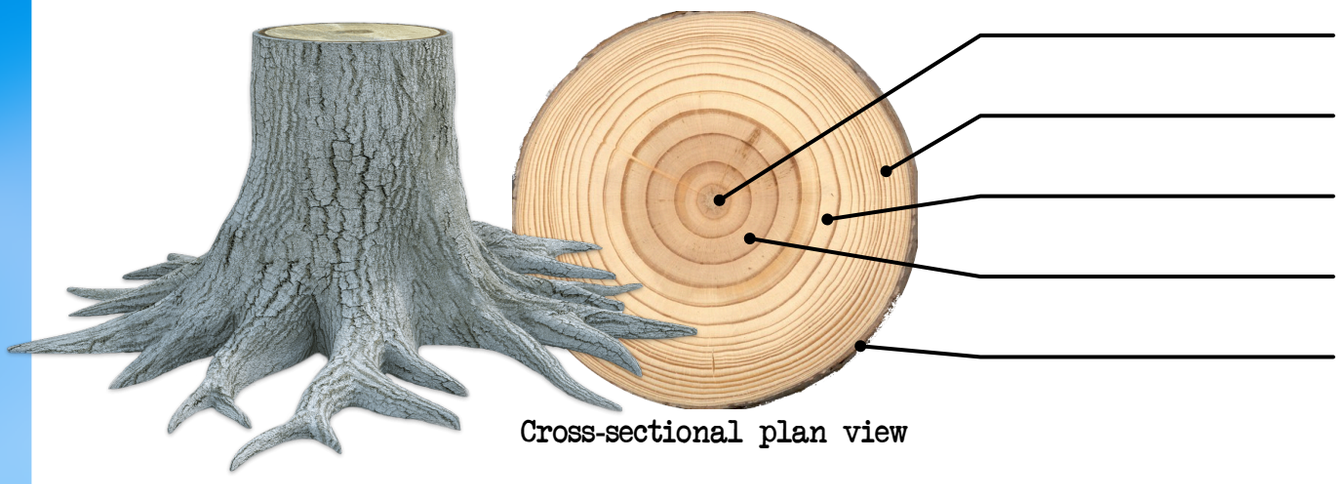
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_____ [2 Marks]

See the wood from the trees...



Cross-sectional plan view

When a tree is cut-down (felled), a stump is left behind. If you look closely at this stump, you may see 'rings'.
For many (but not all!) species of wood, these rings will show the annual growth of the tree. If you count these rings you can get an approximate age to the tree. You will possibly notice different colours to the wood.

Different parts of the wood can have different properties, such as strength or colour. A saw-mill will cut the tree into useful lengths, called 'timber', depending on what the client needs and what will minimise waste.

Research the names to the different parts of wood.

© Be responsible!

Trees are a valuable commodity, but humans are not always careful with forests and environment and are cutting down forests at an incredible rate. Some tree species are endangered, meaning there are so few of them left they may go extinct if cut down. Other forests are cut down, so the land can be cleared and used for farm animals or building work.
We are using trees faster than we replace them and this will have consequences for the future.

The *Forest Stewardship Council* is an international organisation established in 1993 that promotes responsible management of the world's forests. The FSC mark is added to wood-supplies that are from sustainable, managed forests. Designers and engineers should buy their wood from an FSC accredited source.



Wood needs to be dried once felled, or it will start to rot and decay.

In the United Kingdom, the Forestry Commission is the organisation responsible for managing all public forests.
Research your local managed forest. What wood is grown and harvested?

Describe the term 'managed forest', and why this is important for the economy and environment.

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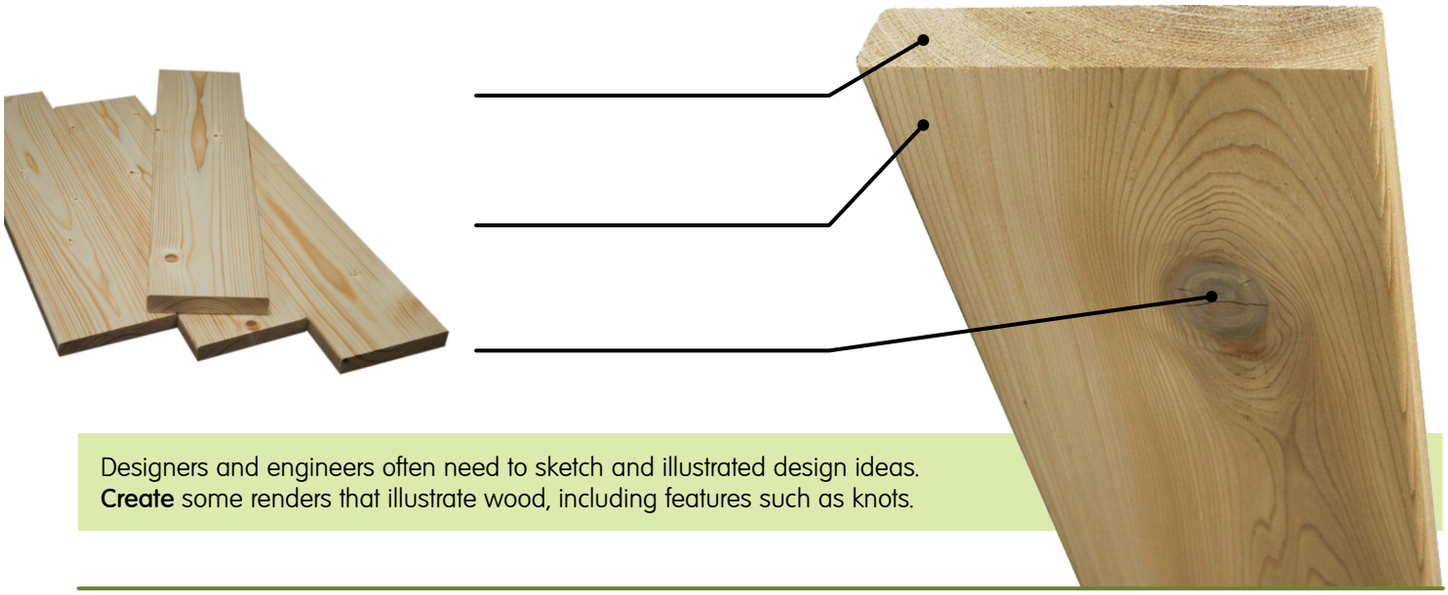
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_____ [4 Marks]

Looking closely at wood...

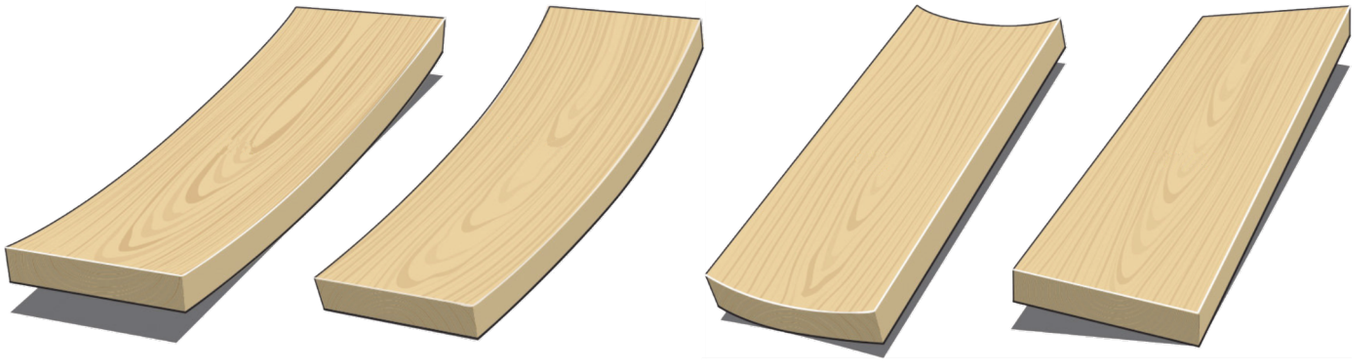
Wood is a natural product, and like all natural products, it can suffer from injuries and defects.
Some features are caused by the environment such as drought or flood, others are caused by wildlife, fungus or disease.
Some features are naturally occurring such as branches.
Most of these features and defects have a name.
State the name of the features labelled below.



Designers and engineers often need to sketch and illustrated design ideas.
Create some renders that illustrate wood, including features such as knots.

Living, breathing materials...

Once a tree has been felled and cut into useful sections, it needs to be carefully dried. Wood is '*hygroscopic*', meaning it will release or absorb moisture depending on the environment it is in. If the moisture level changes too quickly, wood can start to change shape. The wood can 'move' in different ways, and each has a specific name. **State** the name of the type of movement shown below.



_____ _____ _____ _____

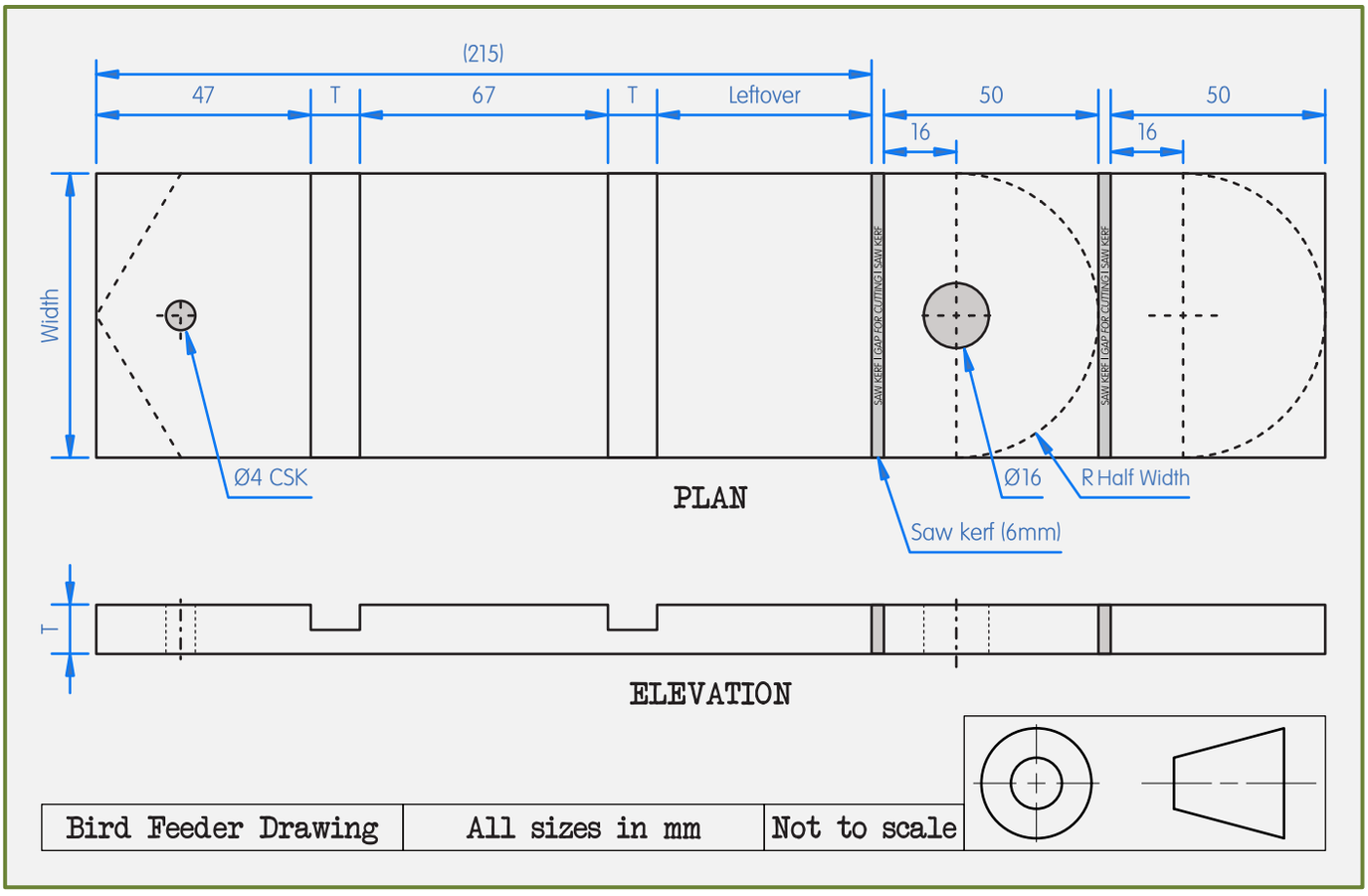
A furniture designer will be making a wooden bench for a garden.
Explain why a furniture designer will allow the wood to 'rest' outside before manufacturing the bench.

_____
_____
_____
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_____ [2 Marks]

Reading drawings

Every designer or engineer needs to be able to read technical drawings.
Technical drawings present information so that a product can be manufactured accurately. Sometimes these drawings can appear complex at first glance, but don't panic. Drawings will show lengths, widths, thickness, radii and hole-diameters.

A technical drawing for a bird-feeder is shown below:



State what 'CSK' means:

_____

Calculate the 'Leftover' material if 'T' = 18mm

_____

Calculate the minimum length of material required, if 'T' = 18mm.

_____

Calculate the width of the material required.

_____

Designers and engineers use technical drawings that are presented in the same way, using 'standards and conventions'
Explain why drawings should all be presented using the same techniques, standards and conventions.

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_____ [2 Marks]

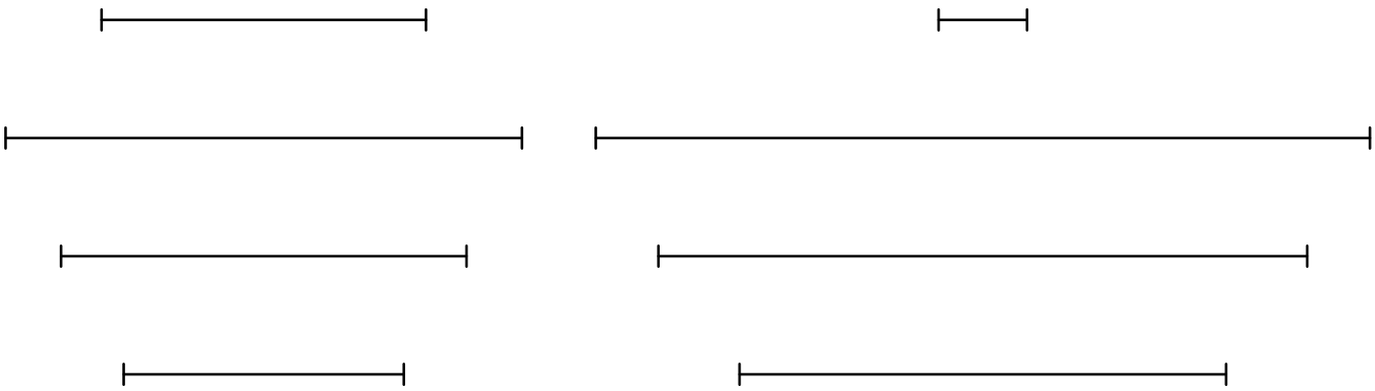
Measuring and marking

Whatever is being manufactured, accurately measuring and makring materials is essential.
Designers and engineers use a range of tools to measure items, including tape-measures, steel-rules and vernier-callipers.

In the United Kingdom, the 'Metric' system is used for measuring; meters and millimeters.

Being able to measure lengths accurately is an important skill that can take practice.

Measure the lines shown below, and write the size above each line. You must use millimetres (MM) for your answer.



A length of wood is shown below.
Divide this into four lengths of 42mm. You must have a 'saw-kerf' between each piece.



The 'metric system' is used by most countries for measuring.
Describe the alternate measuring system, origianlly from the UK and still used in the United States of America.

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Safety first!

All workshops and maker-spaces can be dangerous environments. Different materials, tools, chemicals and processes are used by designers and engineers to turn their ideas into reality. Not following safety rules can result in serious injury or even death. It is essential that safety rules are always followed.

Everybody in a workshop or maker-space is responsible for safety. If you see something dangerous, report it immediately. Alert everyone to the danager and if necessary activate any emergency-stops to turn off gas and electricity. Never touch materials, tools, chemicals or equipment without permission and knowing what you are doing. Stay safe!

A school workshop is shown below. You don't want to be making anything in this space! There are **16** health-and-safety violations taking place, making the space dangerous for everyone. **Identify** all the dangers in this makerspace.



All machines tools can be potentially dangerous.
Describe four rules that apply to using any machine tool.

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_____

_____

_____ **[4 Marks]**

Know your tools!

Every tool has job and every job has a tool! Designers and engineers use a range of tools for manufacturing iterms and it is important to know the name and purpose of each tool. It is also important that any safety rules are followed when using tools.

Twelve common tools are shown below.
State the name of each of these tools.
Describe the purpose of each tool.

























It's all in the finish

Wood is a complex natural material. Like all natural materials, it can decay and rot if not protected properly. Some species wood, such as Cedar, will naturally release oils or change to delay the decaying process. However, long-term protection requires a finish to be applied at regular intervals.

The type of finish applied depends on the species of wood and where it will be used. Wood that will be outside will face harsher conditions that wood inside a building. Different finishes can also impact the aesthetics of the final product. Wood must be suitably prepared for the finish that is to be applied, including sanding the surface and removing any defects.



Sand along the grain

Use glass-paper and sand along the direction of the grain, never across. Sanding across the grain will scratch the wood and leave more marks. Use a sanding-block or scrap piece of wood to make the process more comfortable.



Using incrasing grit

There are different levels of roughness to glass-paper, called 'grit'. The lower the number, the rougher the paper is. Start from a low-grit and gradually work higher, getting the surface of the wood smoother.



Raise-the-grain

Once the wood feels smooth to the touch, use a damp towel to 'raise-the-grain'; this process swells loose fibres of wood so they can be sanded off. This also cleans the surface of dust and wood fibres.



Final sanding

Give the wood a final sanding prior to applying a finish. This can either be with glass-paper, wire-wool or a cabinet scraper. You may want to repeat the process of raising-the-grain prior to applying a finish.



Beeswax

Beeswax is an excellent hardwaring finish that creates soft sheen to the surface of the wood. Beeswax is not a weather-proof finish and cannot be used on products that go out doors.



Danish Oil

Danish oil is absorbed by the wood and creates a deep level of protection. It will have very low sheen to the wood, and will darken the colour of the wood significantly. Not weather-proof.



Polyurethane Varnish

Polyurethane varnish will provide a hard, protective clear shell to wood that is extremely tough. Polyurethane varnish is also suitable for protecting wood that is outside. Generally, varnish is clear and won't alter the colour.



Woodstain

Woodstain will change the colour of wood, whilst also creating a water-proof coating that will protect wood for extreme weather. Most woodstain will be deeply abosorbed by the wood, providing long lasting protection.

Explain why a designer must be careful in selecting an appropriate finish when creating a wooden toy for young children.

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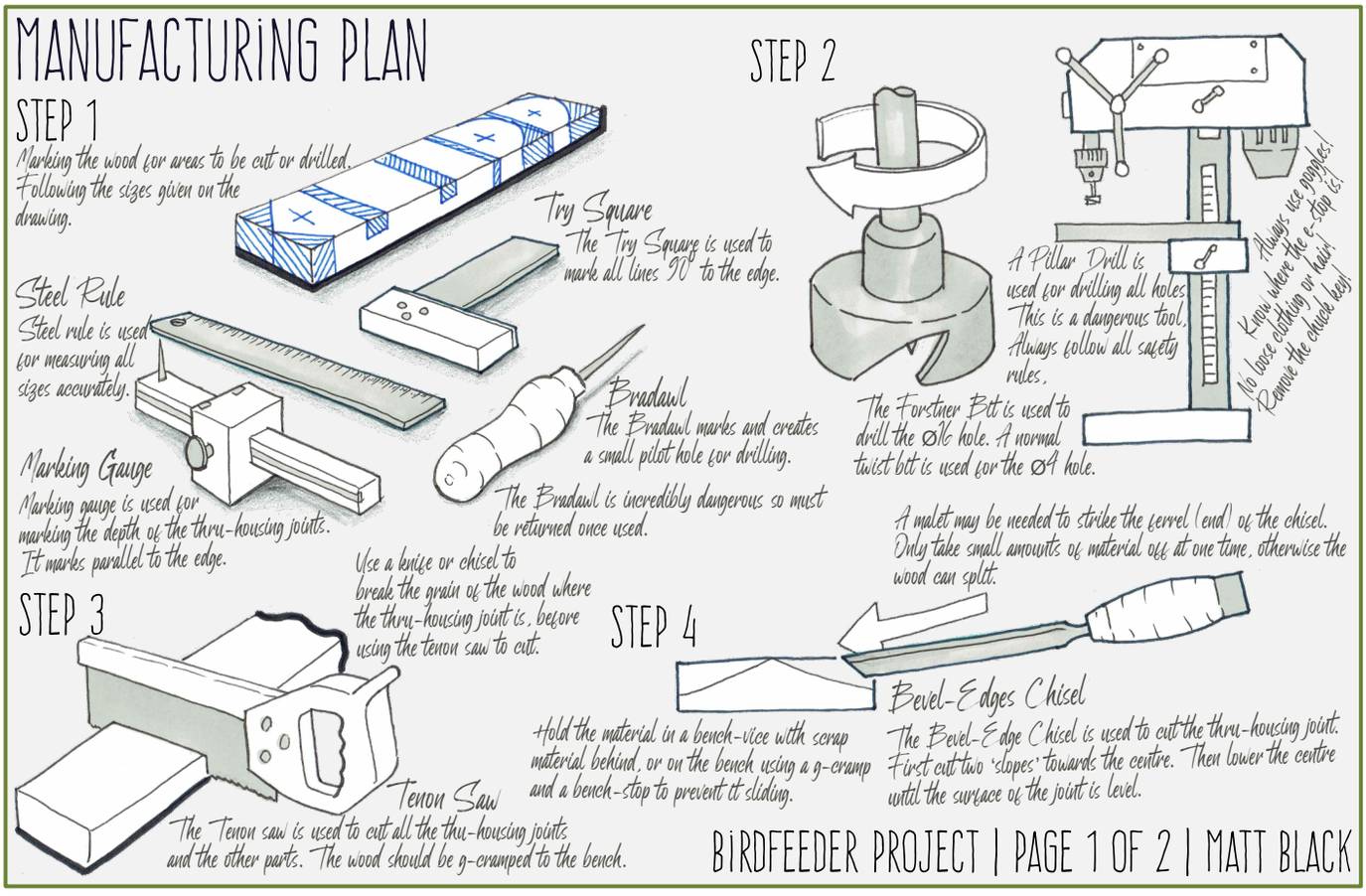
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Planning your making

Making any product can be complex and confusing.
Designers and engineers will plan how they will make their projects before heading into a workshop or maker-space.
They will make a list of the tools, materials, fixtures and finishes that will be required, and what they will use them for.
They will usually make a note of any safety issues that could cause problems.

Some projects may require a part to be made by another person, and this is usually notes.
Designers and engineers may make a detailed storyboard of the manufacuture, so others could make the product.



Practice creating your own manufacturing plans.

Make your plans as clear and as detailed as you can.

Sketches, graphics and photographs are often used for instructions or plans.
Describe the advantages and limitations to using images for instuctions.

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_____

_____

_____ **[4 Marks]**



Course Notes v0.3

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