

Flying Start Challenge



Materials & Manufacturing

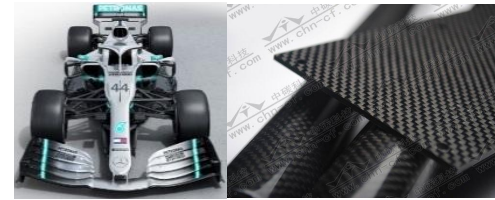
Lesson 4

Learning Objectives

- **Material Properties**
 - Understand different material properties and how they affect weight and strength
- **Your Materials**
 - Learn which materials you will use for your gliders
- **Industry Materials**
 - Learn the modern materials aircrafts are manufactured with and why
- **Manufacture**
 - Understand what manufacturing techniques are used
- **Structure**
 - Understand different designs to create strong structure for aircrafts
- **Sustainability**
 - Learn how to make your glider sustainable
- **Quality & Cost**
 - Learn how to build a successful glider within a budget

Material Properties

- Materials have a big effect on product weight
- Selected depending on purpose
- Carbon Fibre
 - Very light, strong, expensive



- Titanium
 - Lighter than steel, strong, expensive



- Steel
 - Very heavy, strong, cheap



Strength vs Weight

- Think about the strength to weight ratio of your glider materials

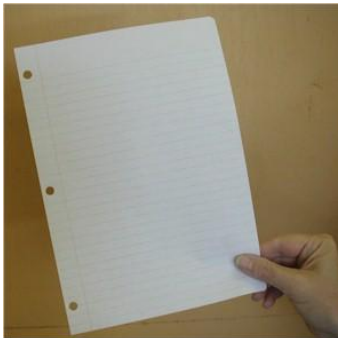


Balsa wood



Tin Foil

Paper



Hardwood

What materials/resources can you use?



Modern Aircraft Materials

Aluminium

Low Density

- Low Weight for a given size

Ductile

- Bends and stretches before breaking (unlike glass, which is brittle)

Malleable

- Easily Shaped (at High Temperatures)

Corrosion Resistant

- Doesn't Rust

Composites

Very Low Density

- Low Weight

Design Flexibility

- Can be formed into very complex shapes

High strength

- Very strong

Durable

- Long life and requires minimal maintenance

Other Aircraft Materials

- **Jet engines are made from Titanium and Nickel alloys**
 - These can withstand immense forces and temperatures

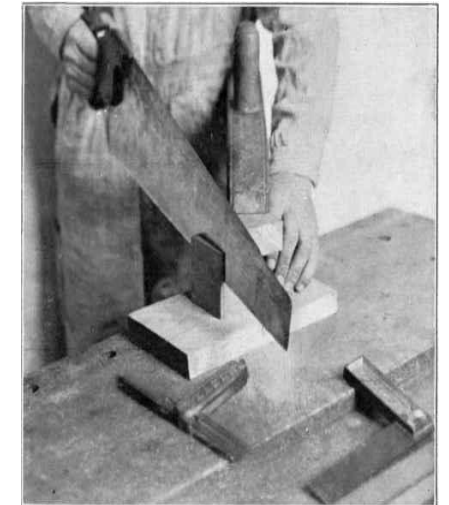
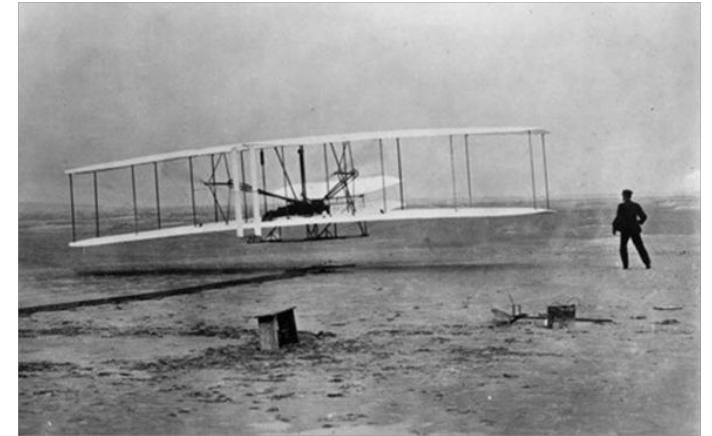
- **Aircraft landing gear are made from Titanium, and Aluminium**
 - They can take incredible loads whilst keeping aircraft weight low

- **Helicopters are made of aluminium**
 - Some also make use of advanced composite materials



Early Aircraft Manufacture

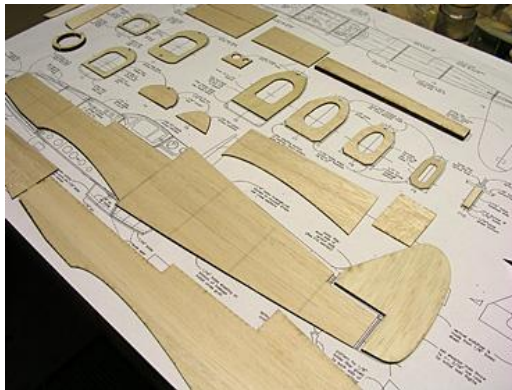
- The first aeroplanes were made from:
 - Wood (structure)
 - Steel wire (controls)
 - Canvas (wing covering)
- Canvas was used as it weighs less than solid wood
- Manufacturing processes were using simple tools



Manufacturing Techniques

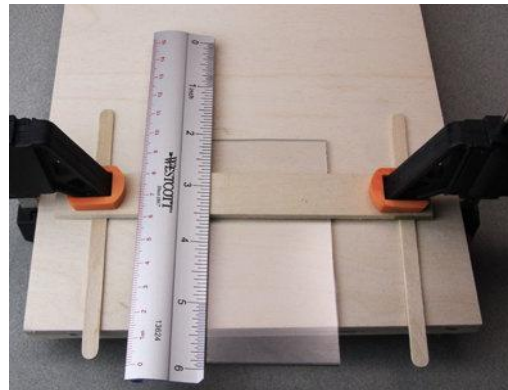
Material Usage

- Minimise wastage
- Plan how you will cut your materials using templates
- Measure twice; cut once!



Shaping

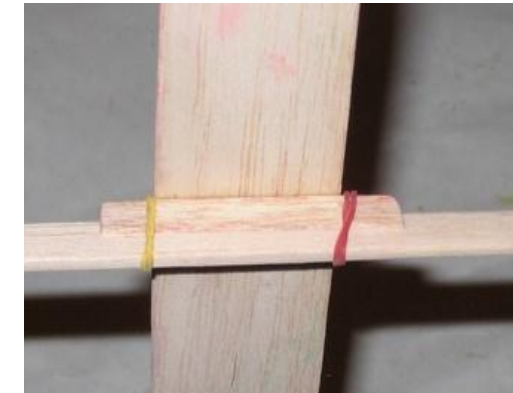
- Use jigs/clamps and templates to keep components accurate
- Cut materials slightly too big so you can then make them smaller by sanding down
- Sand materials to achieve desired shape
- Make shapes smooth and aerodynamic



Joining

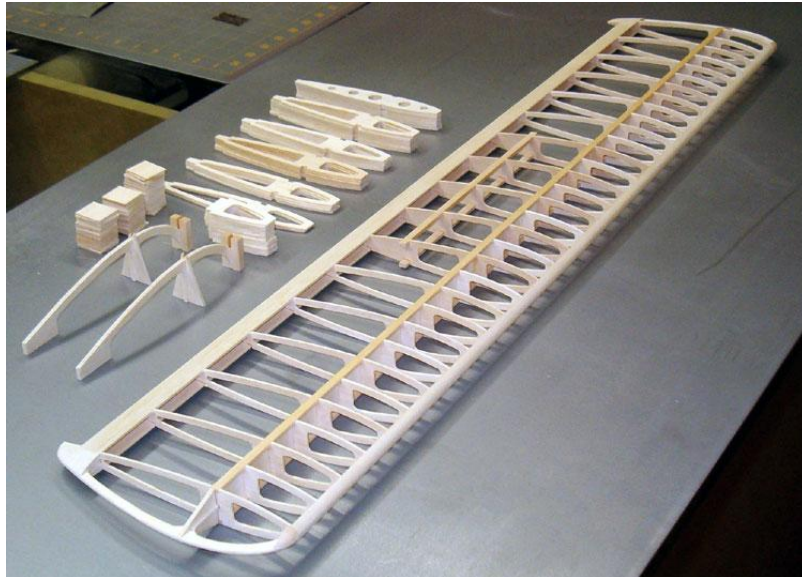
Your main method of joining will be gluing, however you can also use:

- Friction fit
- Tape
- Elastic bands
- Anything else you can think of!



Structure

- You want your glider to be strong, light and durable



Thin but strong structure

Lightening holes



Sustainability

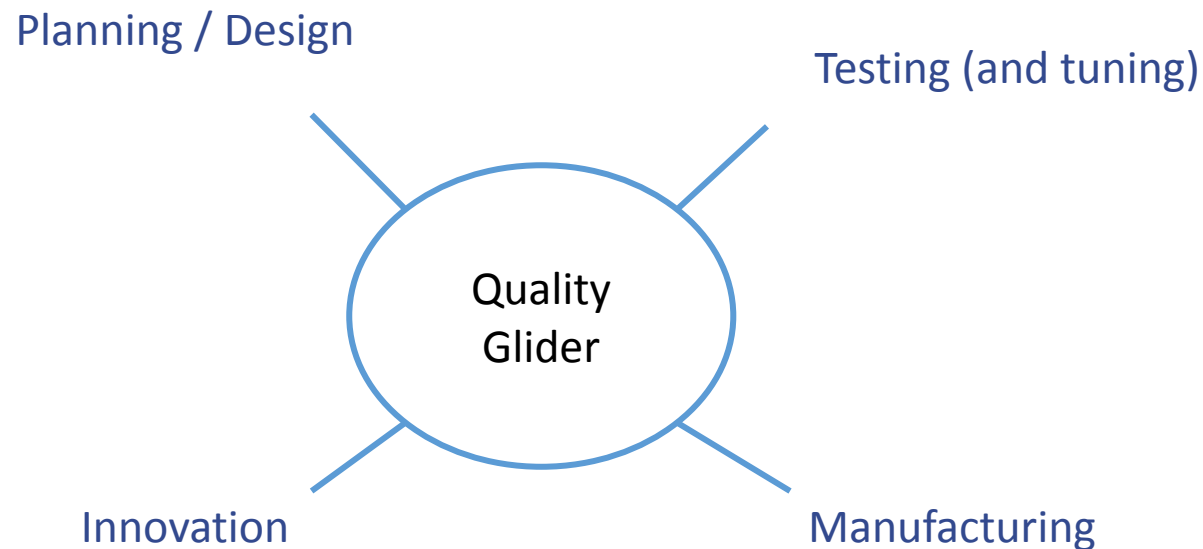
Think about incorporating sustainability in your design.

- Recycled materials
 - For example bottles and newspaper
- Bio-degradable
 - What will happen to your glider at the end of its life
- Modular design
 - Making your glider easy to repair/take apart



Build Quality

What do you have to do to ensure a successful glider?



Learning Highlights

- **Material Properties**
 - Balancing strength and weight of materials
- **Your Materials**
 - Balsa Wood, Hardwood, BluTack, Rubber bands, Glue & Recyclable materials
- **Industry Materials**
 - Aluminium, Composites, Alloys
- **Manufacture**
 - Material Usage, Shaping, Joining
- **Structure**
 - Strong, Light, Durable, Weight Saving Designs
- **Sustainability**
 - Recycled Materials, Bio-degradable, Modular Design