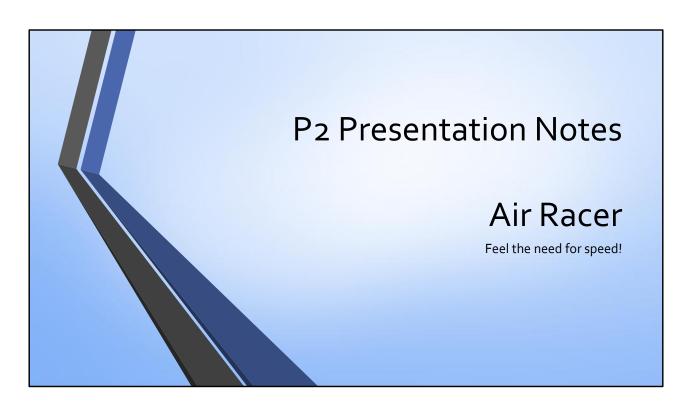


Air Racer P2 Presentation Notes to be given to Class, followed by Setup and operation notes for Presenters P56



Welcome to Air Racer my name is...... Lets get started!



Goal for the day:

To design, build and fly a model air race plane. If your air racer achieves take off and sustains flight for at least 3 circuits, you have achieved success.



Red Bull holds a world Air racer series around the world. These airplanes are fast and exciting to both watch or fly.

Play video



Our Challenge today is to

Build and Fly your own Team Air Racer
 Learn how planes fly.
 Learn how to achieve Straight and Level Flight.
 Design and build a flying air race plane.
 Refine your best design for aerodynamics and style.
 Compete to see which team has the best air race plane

Safety tips:

- Listen carefully to all instructions.
- It is recommended that you wear protective gloves if you are using the hot glue gun to protect your hands from hot glue burns.
- Spinning propellers cut fingers!

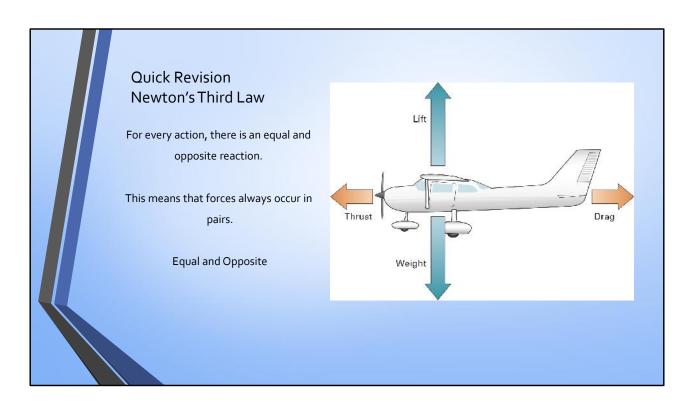
I would like you all to leave with fingers attached.

Be aware we will be working with knives so be careful when cutting parts.

Hot melt glue guns burn so please wear gloves.

Our airplanes have propellers so keep your fingers well clear when powering your motors.

Lets get going!



A Quick revision will help us arrive at the best design airplane.

Newton who lived over 300 years ago came up with some observations and Laws we still use today.

For every reaction there is an equal and opposite reaction.

For an airplane to be in level flight at constant speed

They Lift must equal Weight

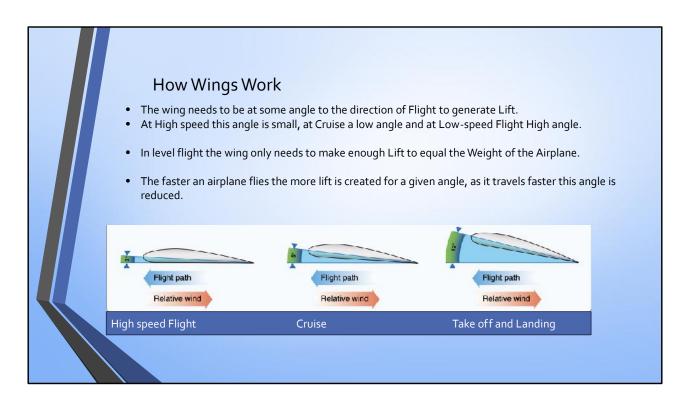
Similarly

Thrust must equal drag

For flight to take place, thrust must be equal to or greater than the drag.

If the thrust is increased so that it's greater than the drag, the plane will speed up.

In summary for flight to take place
Thrust must equal at least drag.
For an airplane to fly faster the thrust must be greater than drag.



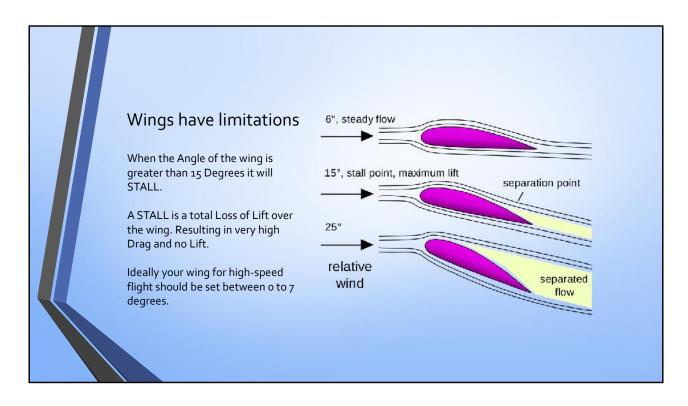
It will help us if we know a little of how wings work.

A wing at zero angle to the flight path will not create Lift.

The wing must be at a small angle to work irrespective of whether it is a flat plate or an aerofoil shape.

The best angle for most aerofoils or wings as about

- 2 degrees for maximum speed,
- 7 degrees for cruise and
- 12 degrees for take off.



Angles above 12 degrees wings start to create very high drag force.
Until at 15 to 17 degrees the wing will stop creating lift because the sir cannot flow smoothly over the wings surface.
This is call a STALL

Your Challenge

- Design, Build & Fly
 - The fastest air racer OR
 - The slowest air racer
- Airplane must take off in less than one circuit to qualify

Our Challenge

Design, Build & Fly

The fastest air racer

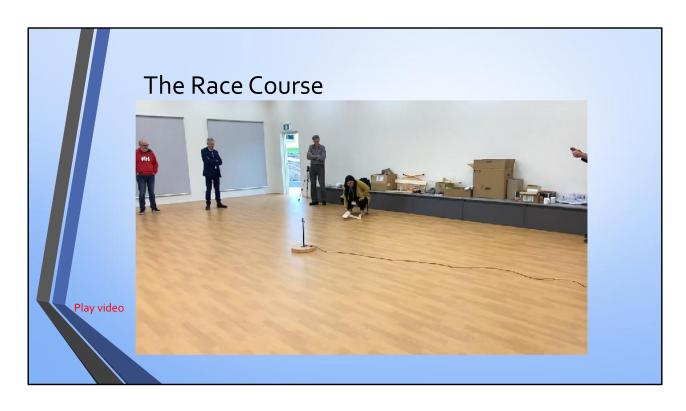
OR

The slowest air racer

Airplane must take off in less than one circuit to qualify

You choose Fastest or slowest

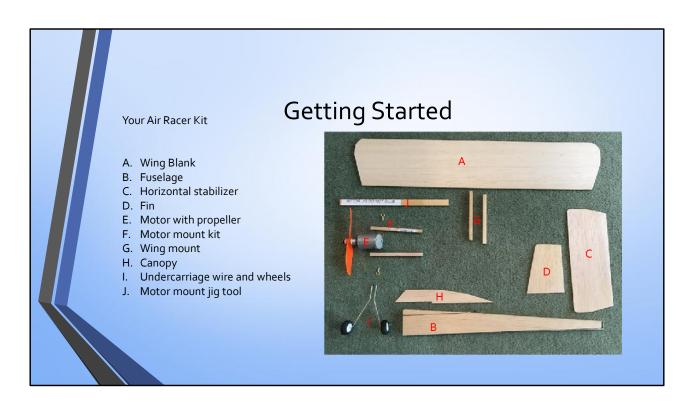
Your decision will impact on your design choices.



Here is the last Carnival air racer in action *Play video*



Here is our standard kit issued to each team. Your are allowed and encouraged to modify it



You can build the basic kit or make it better

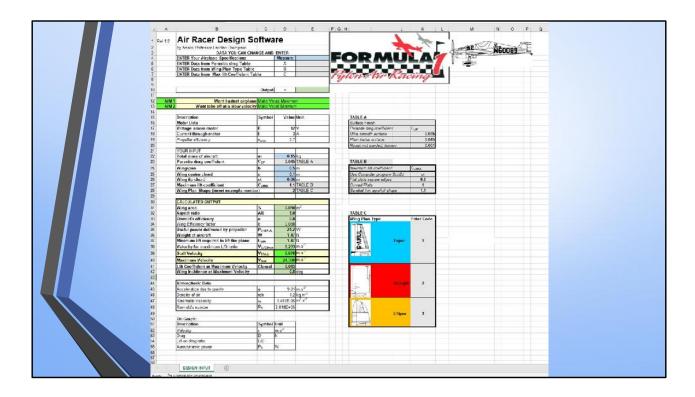
Designing a winning airplane

• We have provided you with an xls spreadsheet airplane design guide Called acdesigner2025.xls

By entering the different parameters of your airplane, you can predict its performance.

You do not have to do the maths and formulas we have given you a spread sheet to do the hard work for you.

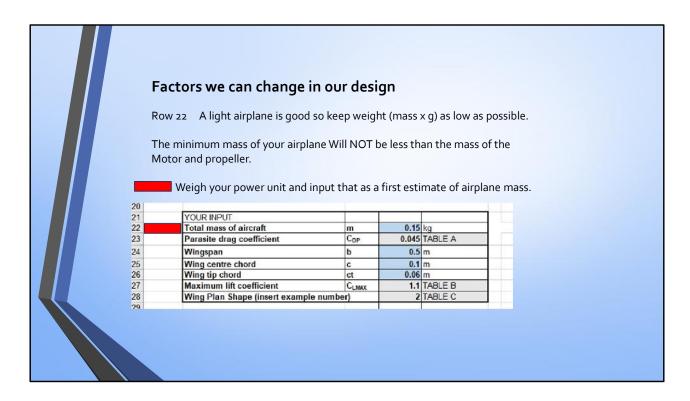
To help you use the spreadsheet here is a user guide.



Welcome to acdesigner2025.xls

It looks like a lot of data but you only need to input 7 bits of data. Four from measuring your airplane these are shaded pale blue and choose 3, one each from Tables A, B & C shaded pale grey.

The Out put you need to act on is bright green Being the slowest speed and the other the highest speed estimated for your design choices.



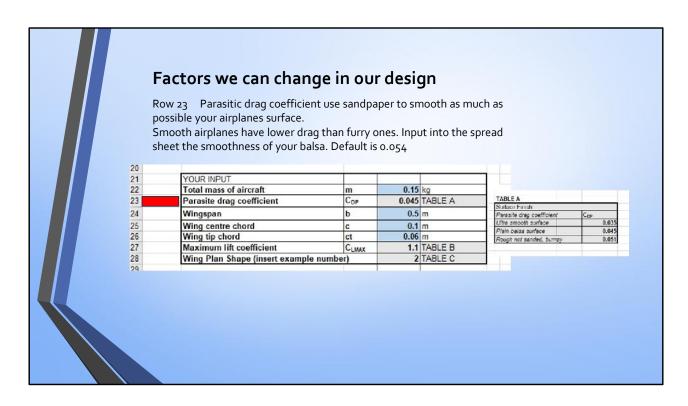
The seven inputs lets have a look.

The first is Row 22 mass that's pretty easy as we have a digital scale.

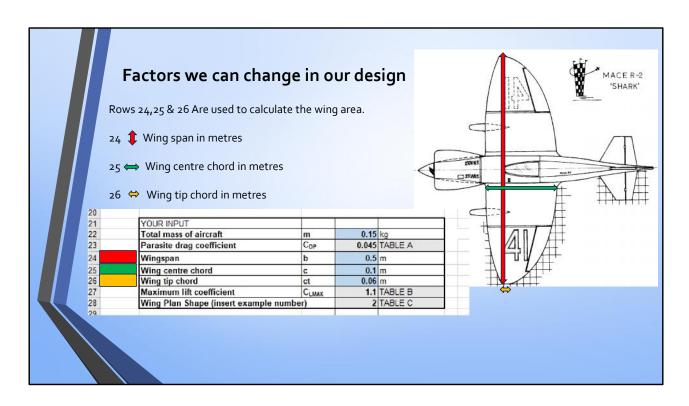
It is good so keep weight (mass x g) as low as possible.

The minimum mass of your airplane Will NOT be less than the mass of the Motor and propeller.

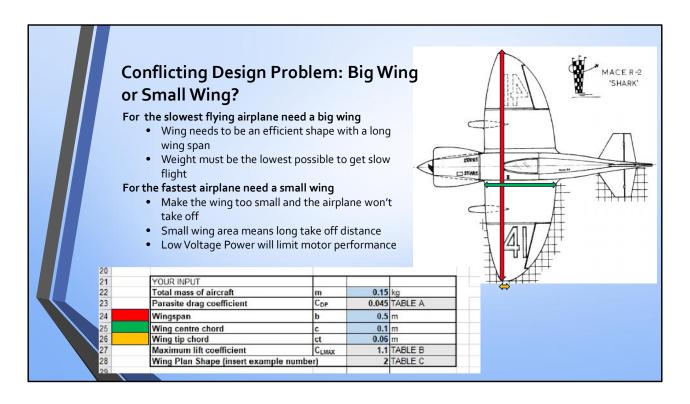
Weigh your power unit and input that as a first estimate of airplane mass.



The second is row 23 a thing called "Parasitic Drag Coefficient" big words but all this is a measure of how smooth your airplanes surface is. You have 3 choices leave the wood as is or sand it smoother. Easy!

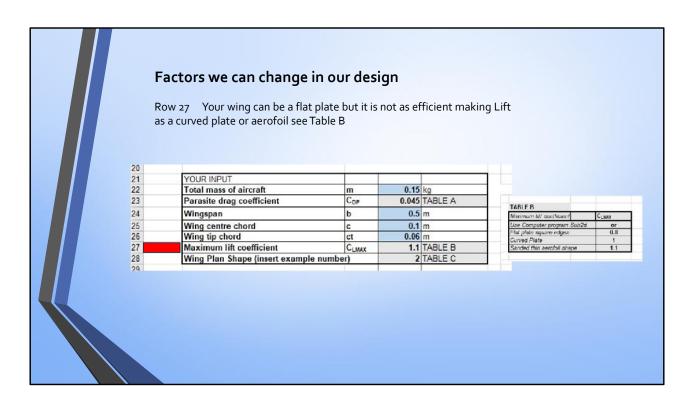


The next rows 24, 25, 26 are simply working out the area of your racers wing. The coloured arrows tell you where to measure your design for wing span, wing root chord and wing tip chord.



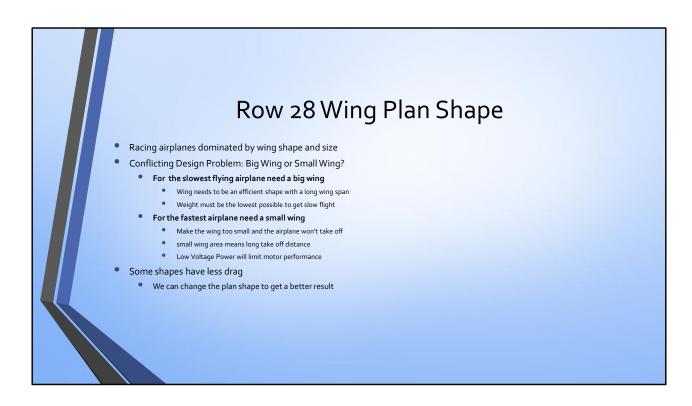
But what if we want a smaller wing.

Use the speadsheet to see haw wing area impacts on the critical speeds.

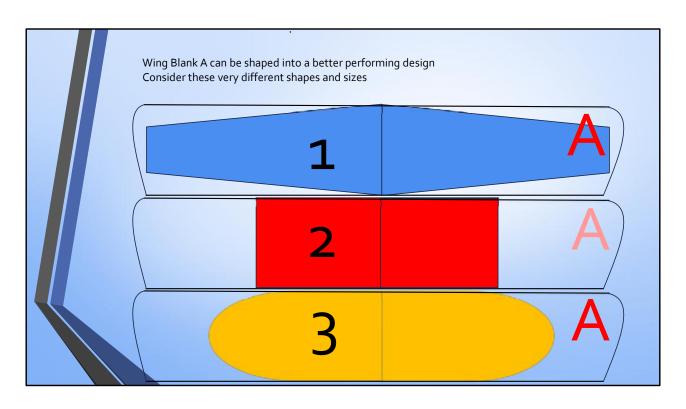


Row 27 depends on whether we want to use a flat plate or sand the front and tear of the wing to a better shape.

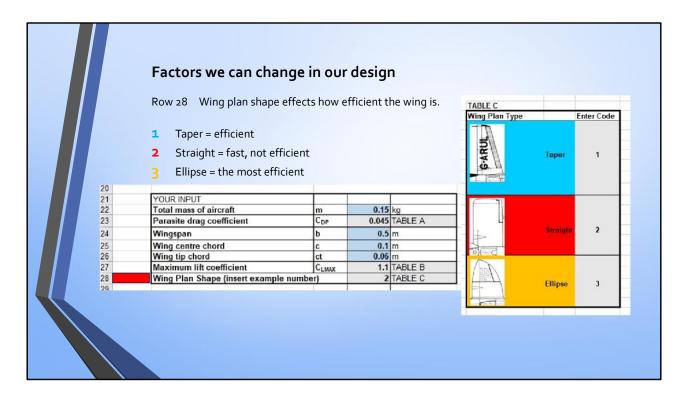
We could even put an aerofoil like curve in our wing. (high lift)



Finally we come to wing plan shape.



Row 28 gives us a choice of 3 types.



This value is a performance factor for the shape

Note for a slow airplane you will need lots of wing area irrespective of what shape you choose.

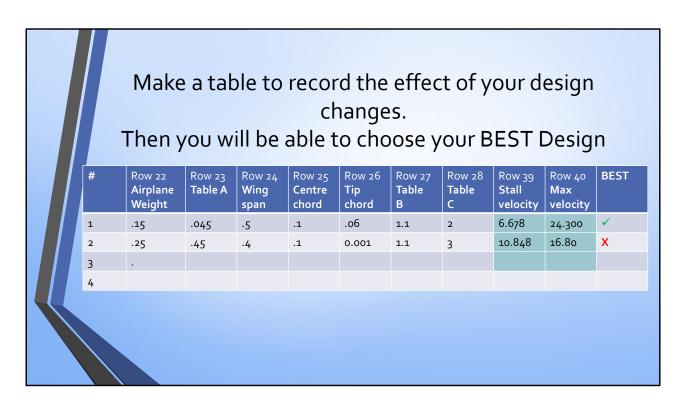
Likewise for a fast airplane you need to make the wing area as small as possible but still be able to take off.



Once you have put this data in the spread sheet will tell you, the designs slowest speed and the fastest speed possible.

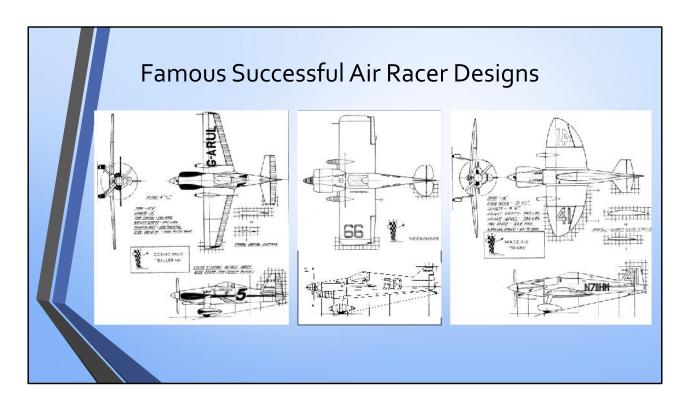
You can change 1 or all 7 parameters to see what effect they have.

But Aerospace engineers advise changing only one parameter at a time.



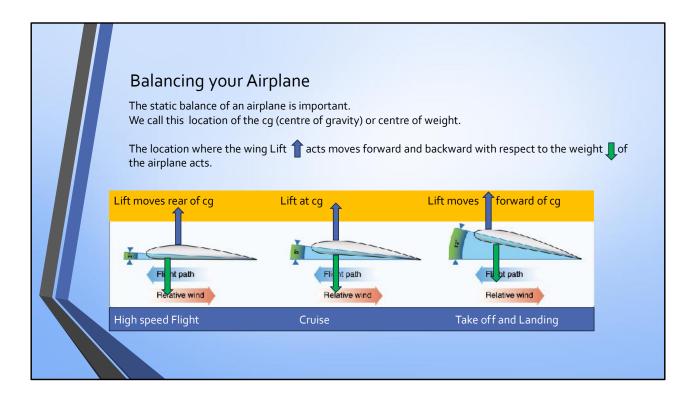
There is a lot you can change. Engineers keep track of changes by using graphs and tables.

Make a table to record your changes. That way you can choose your Best Design wisely.



If there was only one shape that was the best we would not have such a variety in air racer shapes.

So be artistic and well and engineering.



Something I just thought of.

With wings of all types and shapes the point where the lift acts moves forward and back depending on how fast the airplane flies.

Airplane Balance

- Because the centre of lift moves throughout the speed range of flight we MUST balance the airplane.
- The airplane needs to be balanced level or slightly most heavy at 20 percent of average wing chord.
- This balance rig is available to your team.



To ensure a stable airplane aerospace engineers will balance the airplane at about 20% of wing chord behind the leading edge.

We have a special balance jig you will use to get the wing and balance point set correctly.

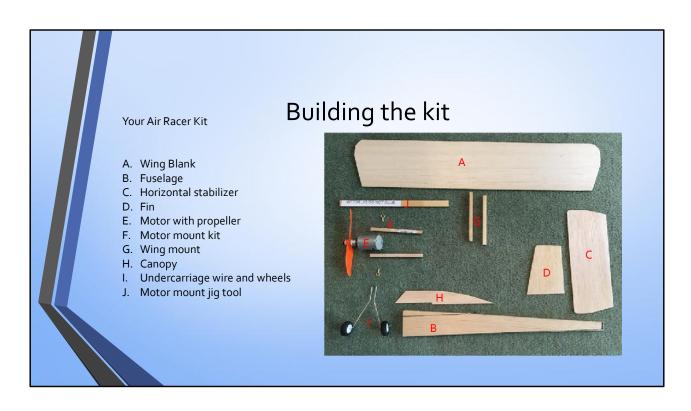


It is also a good idea to add trim tabs to your design so you can adjust the flight.



Our activity has been run at RMIT University for many years. Other Universities such as this on Bristol use the activity to introduce their Aerospace Engineering students to how airplane fly.

Play video



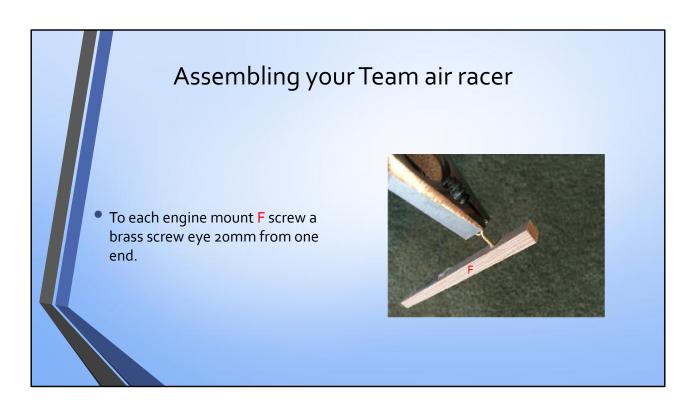
Building our airplane. You can change shapes but I will just do a quick walk though of what is involved building the basic kit.



BEFORE YOU GLUE THINK

It is easier to work out what wing shape and changes you have designed FIRST

That way you can easily cut and reshape the parts.

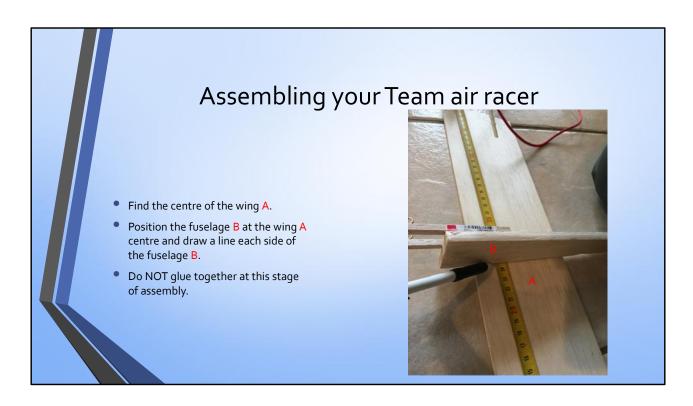


First step in assembling the basic Kit is to fit the two engine mount screws to the engine bearers. These will be used to hold the motor in place.

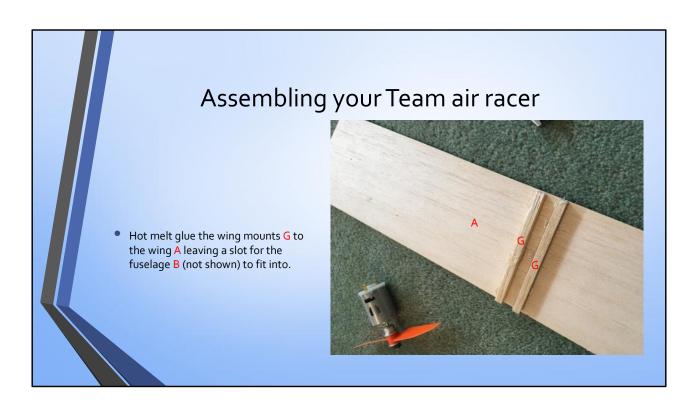


There is a jig to ensure the engine bearer is in the correct position so I suggest you use it.

Glue the bearers as shown into position.



Next mark a centre line of the wing and place the fuselage in position along this line. Then draw a line on the wing along each side of the fuselage.



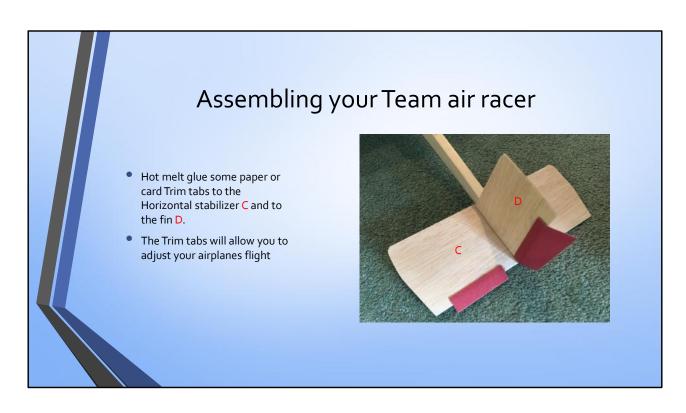
Then glue the wing mounts to the wing. These will help you position the wing on the fuselage later.



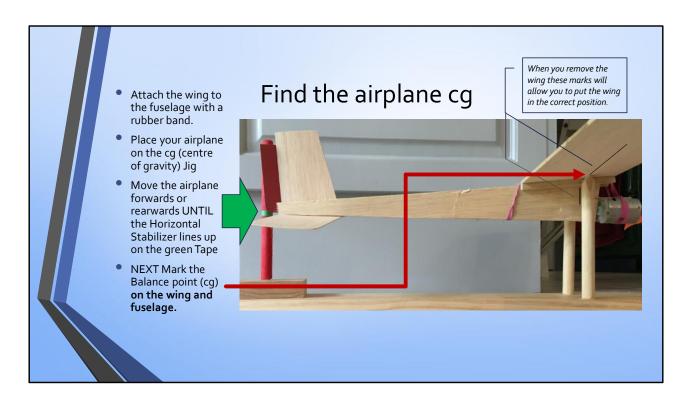
Then glue the Fin to the fuselage.



Followed by gluing the horizontal stabilizer



It's a good time to add some trim tabs from paper of light card.



Attach the wing to the fuselage with a rubber band.

Place your airplane on the cg (centre of gravity) Jig

Move the airplane forwards or rearwards UNTIL the Horizontal Stabilizer lines up on the green Tape

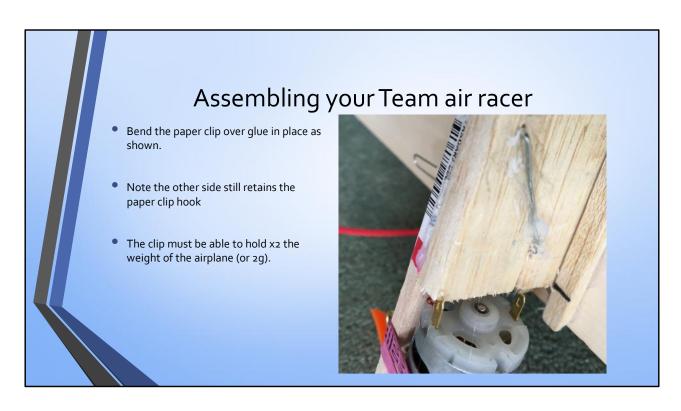
NEXT Mark the Balance point (cg) on the wing and fuselage.



You need next is a LARGE paper clip.



Straighten the Paper clip and pass it through the fuselage at the marked cg.



Bend the paper clip over glue in place as shown.

Note the other side still retains the paper clip hook

The clip must be able to hold x2 the weight of the airplane (or 2g).



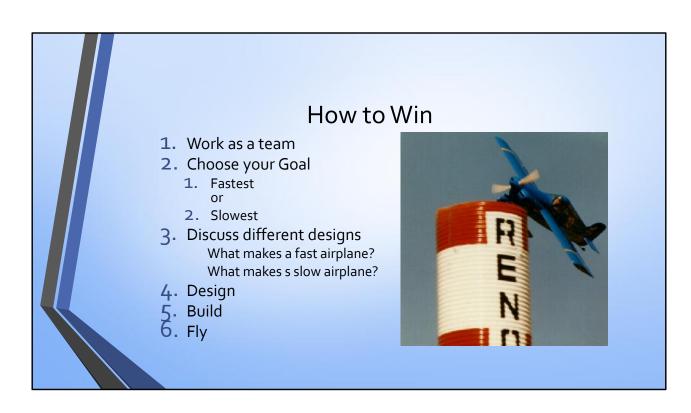
With the wing off it's a good time to glue the landing gear in place.



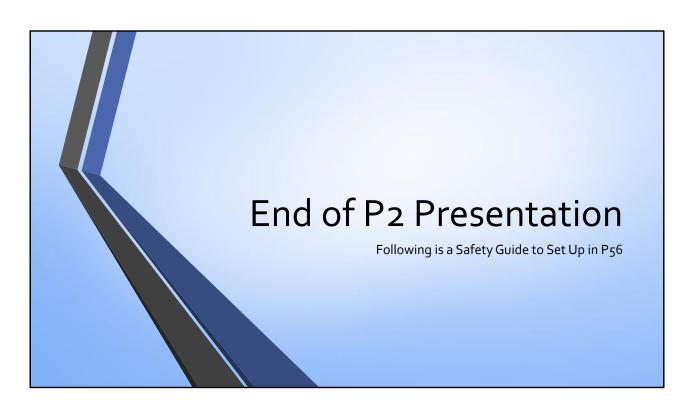
Well Done! We have a basic air racer that will fly?



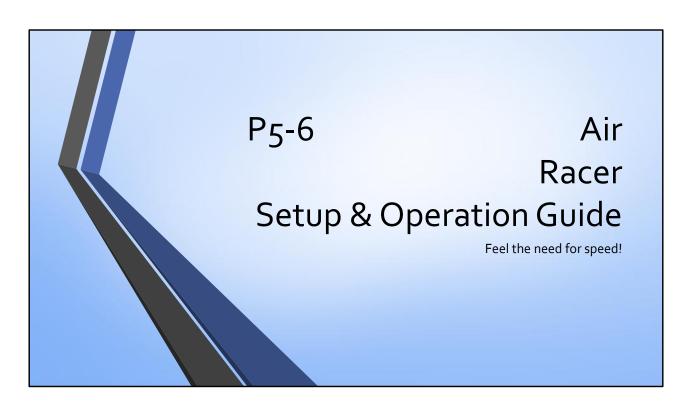
Now is the time to Design and Build then we Fly!



Remember! Team work win!



This Ends P2 Presentation For DEMONSTRATORS the following is a setup and Operations Guide for P56



Welcome to Air Racer



Goal for the day:

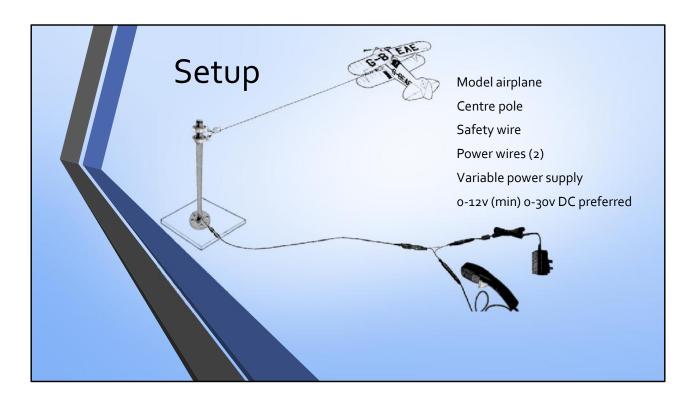
To design, build and fly a model air race plane. If your air racer achieves take off and sustains flight for at least 3 circuits, you have achieved success.

SAFETY:

- Warn students to stay outside the Bollard Safety Tape Circle
- Control Power must be OFF before fitting airplane to wire.
- ALL Students and staff must be outside the circle on power up and operation.
- Spinning propellers cut fingers!

I would like you all to leave with fingers attached.

Our airplanes have propellers so keep your fingers well clear when powering your motors.



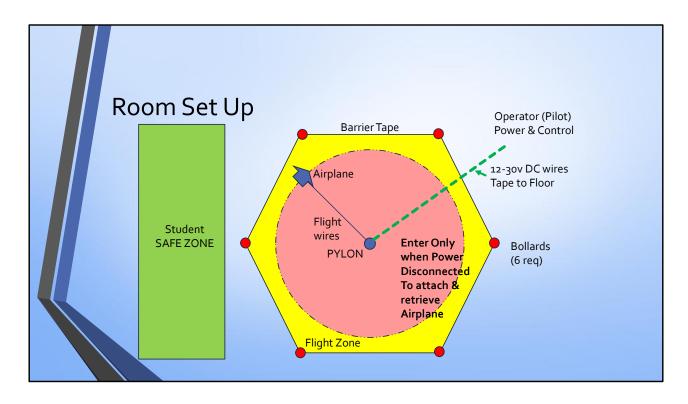
The set-up consists of a power supply, a method of controlling the power, a central pole, tether wires and a model airplane.

This all connects together as follows.

The model to be flown is fitted with a 12volt D.C. electric motor which is connected through finely insulated electrically conductive flying wire to the pole mounted contacts.

A pole equipped with a series of freely revolving electric contacts. The contacts are in turn connected to a low voltage D.C. power source through a variable power supply. The controller allows power to the motor to be varied over a wide range and it is by carefully timed and gauged power alterations that the model can be made to take-off and perform airborne manoeuvres under complete control.

The power supply of 12 – 18 volts is suitable for the 3 metre flying wires



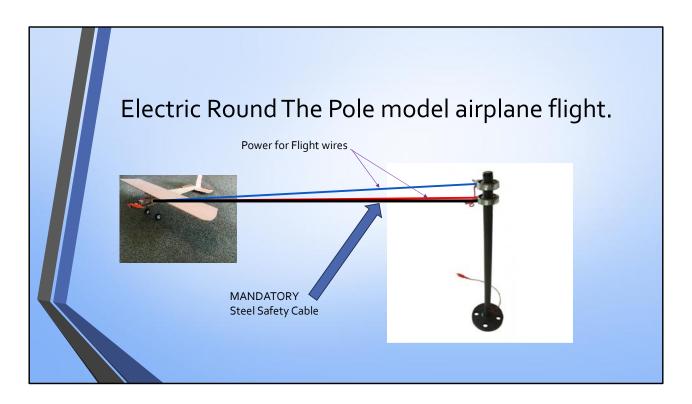
WARNING The Airplane can travel at 4 metres per second or faster.

PERSONS ARE NOT PERMITTED INSIDE THE BOLLARD BARRIER TAPED ZONE UNLESS

POWER IS DICONECTED

Set Up

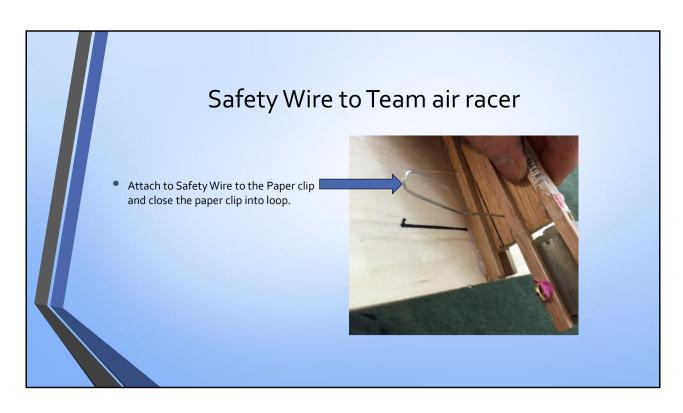
- 1. Place Pylon in centre of room
- 2. Run ground wires to nearest power outlet
- 3. Tape these wires to the ground
- 4. Attach STEEL SAFETY WIRE to Pylon
- 5. Place Bollards 1 Metre further out than reach of steel wire (4m Radius)
- 6. Add Barrier tape to close off circle
- 7. Brief Students of Safe Zone and Not to enter Bollard Flight Zone UNLESS INSTRUCTED when Power OFF
- 8. A Student may Hold the wing Tip for Release with their body and HEAD outside the Flight Zone



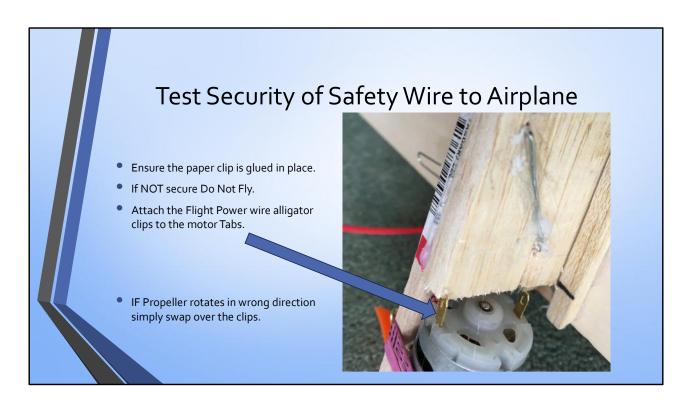
There are two sets of wires connecting the airplane to the pylon.

MANDATORY is the Steel Safety Wire. This is designed to retain the airplane to the pylon during flight operations.

The other is a twin core power wire with Alligator clips at the airplane end. This wire is for Power ONLY and cannot be used instead of the safety wire.



Straighten the Paper clip and pass it through the fuselage at the marked cg.



Bend the paper clip over glue in place as shown.

The clip must be able to hold x2 the weight of the airplane (or 2g).

Ensure the paper clip is glued in place.

If NOT secure Do Not Fly.

Attach the Flight Power wire alligator clips to the motor Tabs.

IF Propeller rotates in wrong direction simply swap over the clips.



Well Done! We are ready to fly