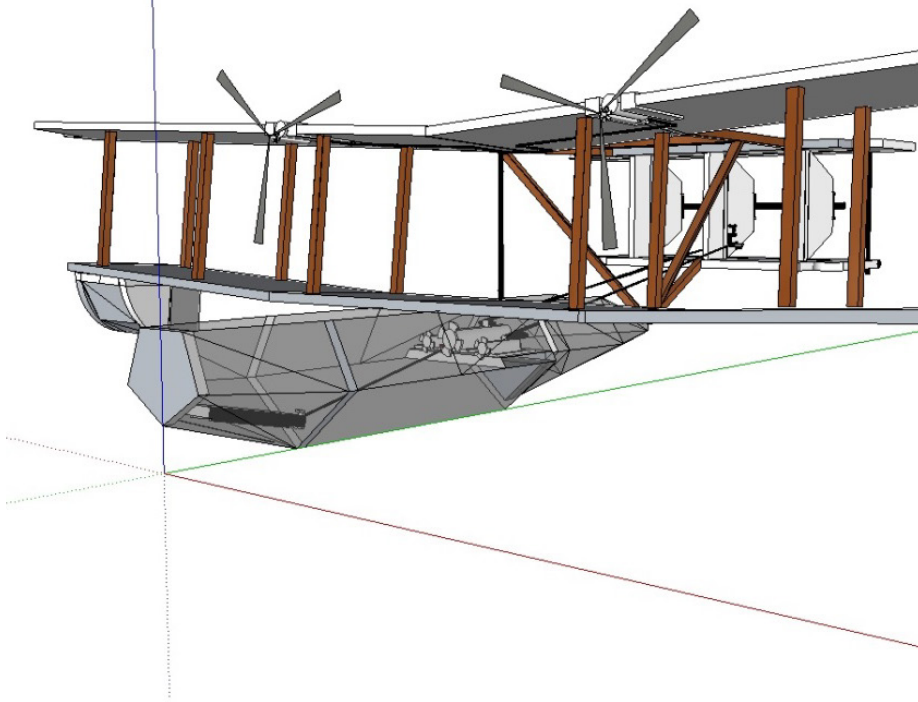


Seaplane Challenge Build Instructions



We are going to build a model of the Navy-Curtiss NC-4 Flying Boat – the very first aircraft to fly across the Atlantic Ocean! Your model will be a glider, or an airplane without a motor. After you finish, you can decorate your model to look like the real NC-4, or any way you would like!

Materials

- Templates (6 pages)
- 3D printed parts
- 13 Regular drinking straws
- Pencil
- Scissors
- Ruler
- Hole punch
- Tape (clear, non-removable preferred)
- Hot glue gun or white glue (optional)

Key

- Solid Line: Cut here
- Dotted Line: Fold here
- (2x): two times

Vocabulary

Hull – Part of a boat that sits in the water. On this seaplane, it is the “body” of the airplane. On other kinds of airplanes, the body is called a *fuselage*.

Bow – Front part of a hull

Aft – Back part of a hull

Leading Edge – Front edge of a wing

Trailing Edge – Back edge of a wing

Spar – A stiff rod or bar that keeps parts from bending. This model uses drinking straws to make spars.

Strut – A stiff rod or bar that holds other parts together. This model uses drinking straws to make struts.

Rivet – A kind of fastener, like a screw or a nail.

Dihedral – The angle between the left wing and the right wing. Dihedral can help to make an airplane stable. On this model, the lower wing has dihedral.

Boom – A stiff rod or bar that acts like both a spar and a strut.

Truss – A bunch of struts connected together.

Building the Tail

Tail Components:

T1: Lower Horizontal Tail

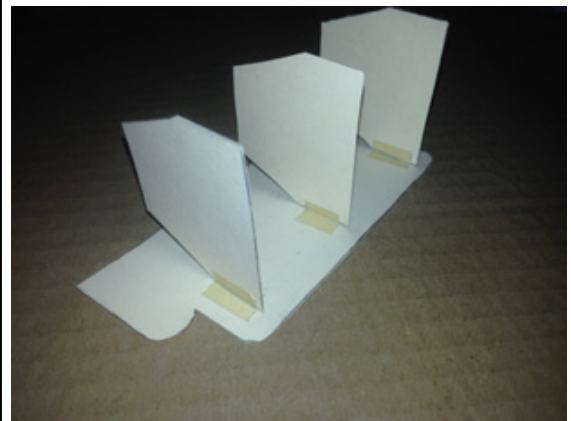
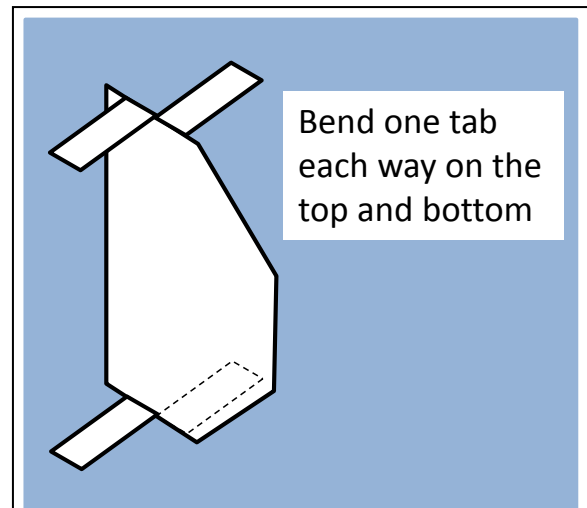
T2: Upper Horizontal Tail

T3: Vertical Tail (3x)

Instructions:

- 1) Cut out all the pieces of the tail.
- 2) Bend the tabs on the Vertical Tails (T3). Using the tabs, tape the Vertical Tails to the Lower Horizontal Tail on the marked lines. The Vertical Tails should be perpendicular to the elevator.
- 3) Tape the other side of the Vertical Tails to the Upper Horizontal Tail, making sure that they line up with the lines on the template.

Congratulations! You have completed the tail!



Step 2: Tape the Vertical Tails to the Lower Horizontal Tail



Step 3: Tape the Vertical Tails to the Lower Horizontal Tail

Building the Wings

Wing Parts:

W1: Middle Upper Wing Section

W2: Outer Upper Wing Section (2x)

W3: Lower Wing Section (2x)

Wing Spars:

Upper Wing Spar – straw length to be measured in step 8

Wing Struts:

4x Inner Wing Struts—60 mm straw

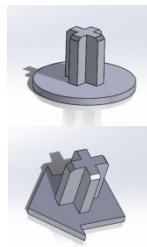
4x Middle Wing Struts—50 mm straw

4x Outside Wing Struts—40 mm straw

3D Printed Parts

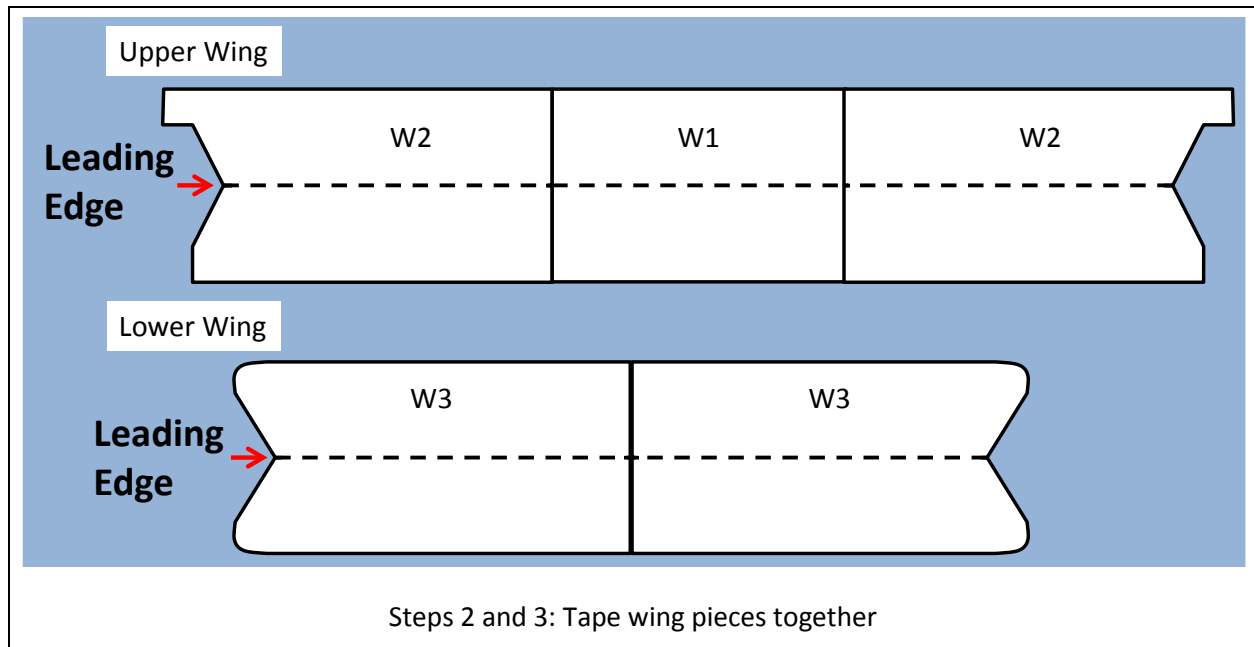
12x Upper Wing Rivets

12x Lower Wing Rivets

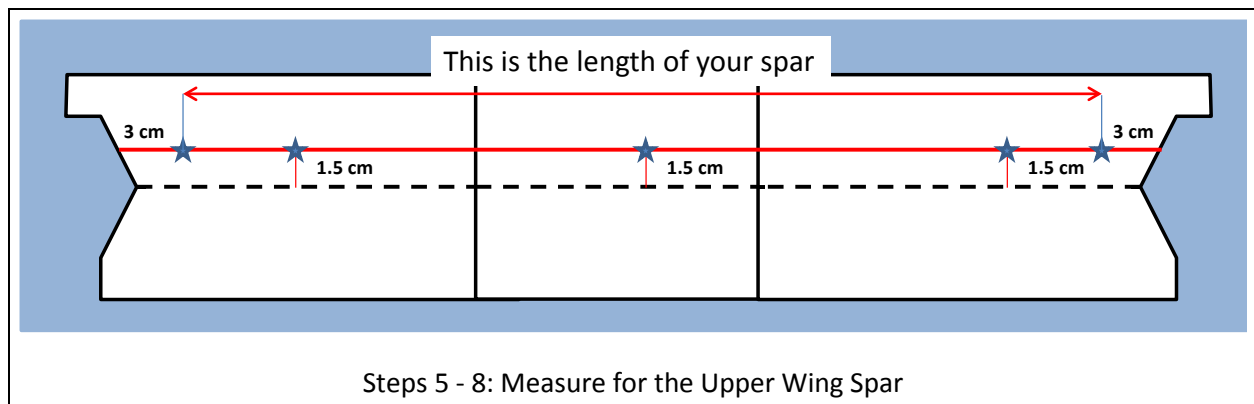


Instructions:

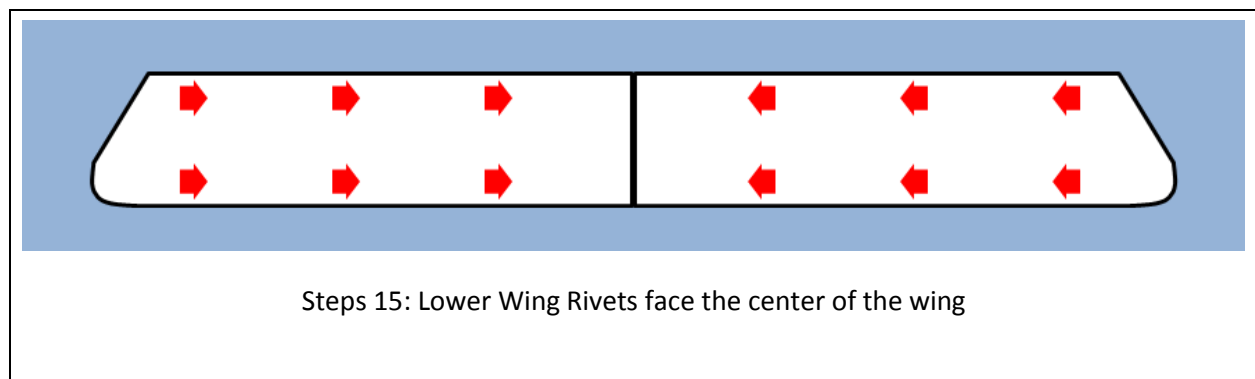
- 1) Cut wing parts from templates.
- 2) Fold along dotted lines to form creases. If a crease looks like it is going to tear, you can reinforce it with tape. This fold will be the **LEADING EDGE** (**front**) of the wing.

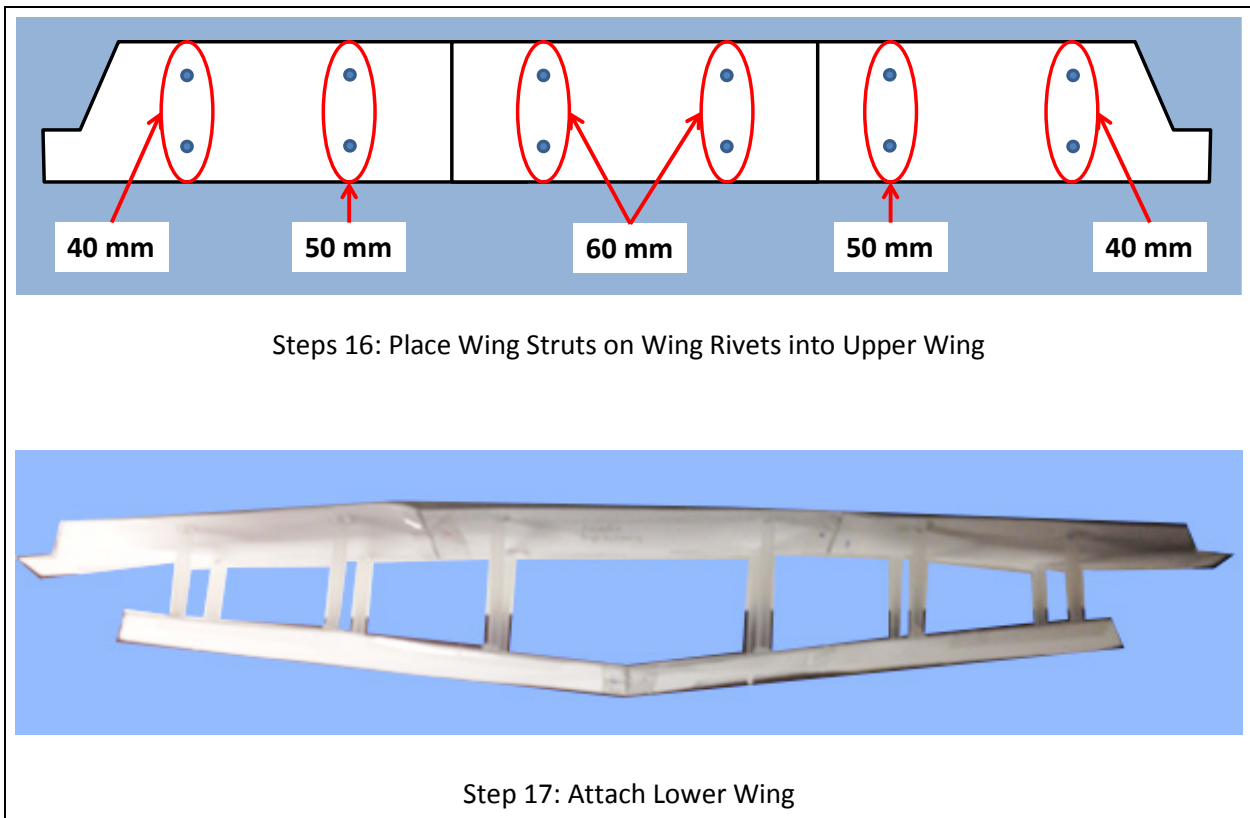


- 3) Tape all three upper wing pieces together, making sure that the circles are all on the same side.
- 4) Tape both lower wing pieces together, making sure that the circles are all on the same side.
- 5) Upper Wing: on the side of the paper WITHOUT the printed marks, measure a point 1.5 cm above leading edge (the folded crease) in at least 3 places.
- 6) Using a ruler, draw a straight line connecting the marks and extending to the wingtips (ends of the wing).



- 7) Measure 3 cm in from the left and right ends of the wing and mark the line.
- 8) Measure the length of the line between the marks – this is how long your Upper Wing Spar needs to be. You can write the length near the line.
- 9) Cut out the Upper Wing Spar from straws using the length you measured in step 8 (If you need more than one straw, tape them together).
- 10) Tape Upper Wing Spar over the line you drew in step 6, between the points you measured in step 7.
- 11) Fold and tape the two surfaces of the wing together with the spar on the INSIDE. Try and keep the lower surface (the side with the marks) flat.
- 12) Fold Lower Wing at leading edge and tape upper and lower surfaces together (marks on the outside). There is no spar for the Lower Wing.
- 13) Using a hole punch, make holes where marked on the Upper and Lower Wings.
- 14) Insert the Upper Wing Rivets through the holes in the Upper Wing and tape or glue in place.
- 15) Insert the Lower Wing Rivets through the holes in the Lower Wing with the arrow of each facing towards the center of the wing. Tape or glue in place.





- 16) Place Wing Struts onto Upper Wing Rivets – shortest on the outside, longest on the inside. Tape or glue in place.
- 17) Place Lower Wing onto Wing Struts. Note that you will need to bend the Lower Wing in the middle. This is called *dihedral*.
- 18) Once everything fits, tape or glue the struts to the wings.

Congratulations! You have completed the wings!

Building the Seaplane Hull

Hull Parts:

H1: Main hull body

H2: Bulkheads (2x)

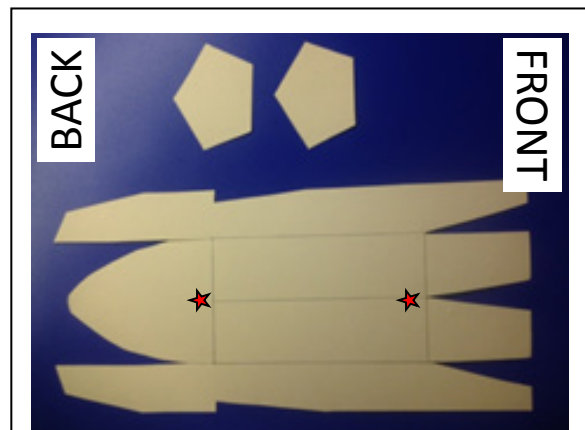
H3: Nose Cover

H4: Back Hull Cover

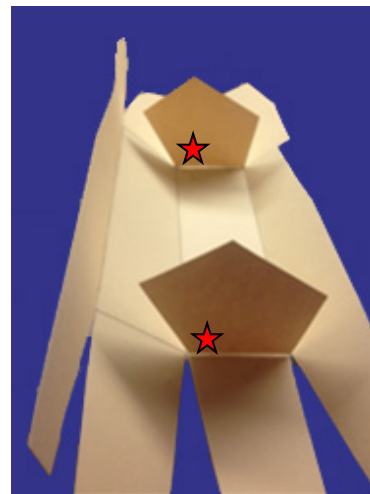
H5: Front Hull Cover

Instructions:

- 1) Cut out all the hull parts H1 – H5 from the templates. Fold H1 along the dotted lines to make creases.
- 2) Place an H2 Bulkhead on the dotted line closest to the **bow (front)** of H1. Stars on H2 should match stars on H1. Use the tabs on H2 to tape the piece onto H1.
- 3) Repeat with the second (aft) H2 Bulkhead towards the hull's tail.

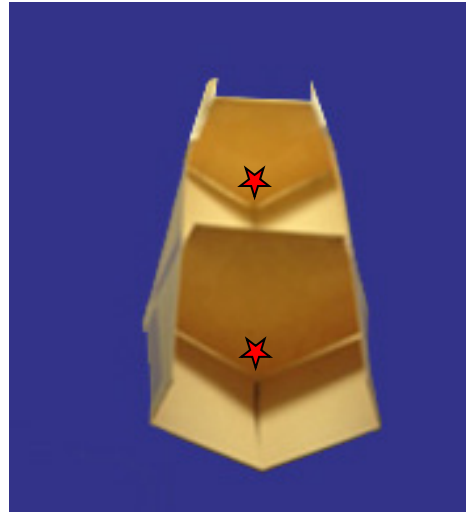


Step 1: H1 and 2x H2 shown (Front or **bow** on the right)



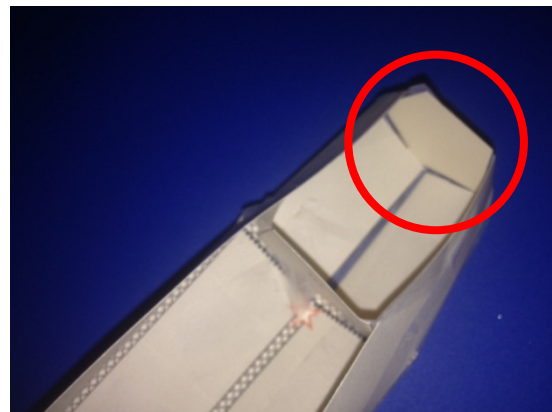
Steps 2 and 3: H2's attached to H1

- 4) Fold the bow (front) of the hull so that the 4 sides touch both H2 Bulkheads and tape in place.
- 5) Tape bow of hull together.



Steps 4 and 5: Fold up the hull

- 6) Tape nose cover (H3) in place at the bow (front) and trim any parts that protrude.



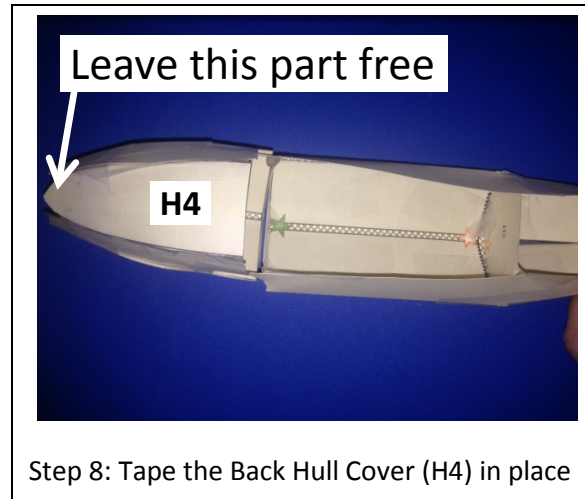
Step 6: Place the nose cover (H3) on the front of the hull

- 7) Tape the tail of the hull together, but leave the end open – you will need to put a piece in the back later.

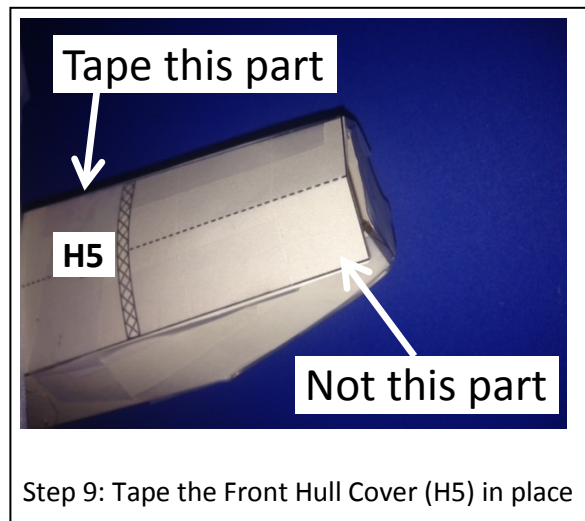


Step 7: Tape the tail together

- 8) Tape the Back Hull Cover (H4) in place. It should cover from the tail to the rear H2. Leave the very back end free for now so you can get in later!



- 9) Attach the Front Hull Cover (H5) to the hull but tape ONLY THE BACK PART (towards the middle of the hull). You will need to get inside the front of the hull later to make the plane fly! (Don't worry if you taped the whole thing, you can open it up with scissors or by peeling the tape).



Congratulations! You have completed the hull!

Assembling the Plane

Plane Components:

Hull

Wings

Tail

Tail Truss Components:

Hull-to-Tail Boom—100 mm

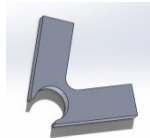
2x Truss Legs—90 mm

Crossbar—105 mm

2x Wing-to-Tail Booms—170 mm

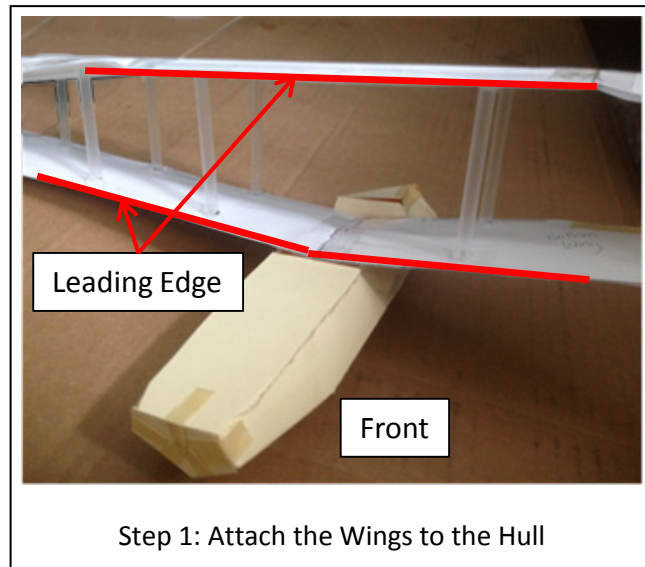
3D Printed Parts

3x Truss Connectors

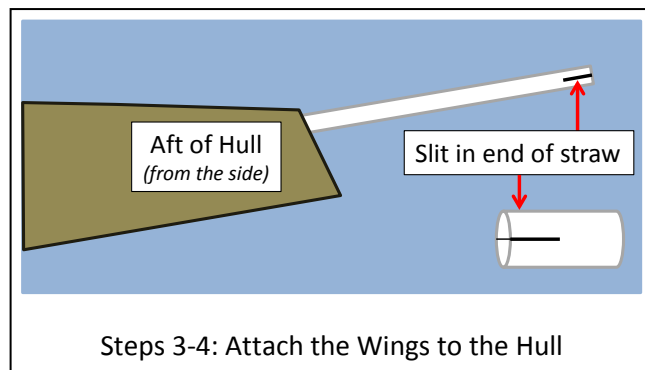


Instructions:

- 1) Attach the Wings to the Hull using tape or glue. The wing should cover the open space on the top of the hull and the Trailing Edge should rest against the aft bulkhead. Remember: Leading Edge is Forward!



- 2) Cut straws to make Tail Truss Components
- 3) Measure 1 cm from the end of the Hull-to-Tail Boom and mark it. Insert this end of the Hull-to-Tail Boom into the **aft (back)** of the Hull and tape together so that the straw stays in place.



- 4) Cut a short slit (about 10 mm) in THE OTHER END of the Hull-to-Tail Boom so that a sheet of paper can slide in between. This slit should be *horizontal*.
- 5) Cut short slits (about 10 mm) in both ends of the Wing-to-Tail Booms. These slits must be *horizontal* and *parallel* (=).



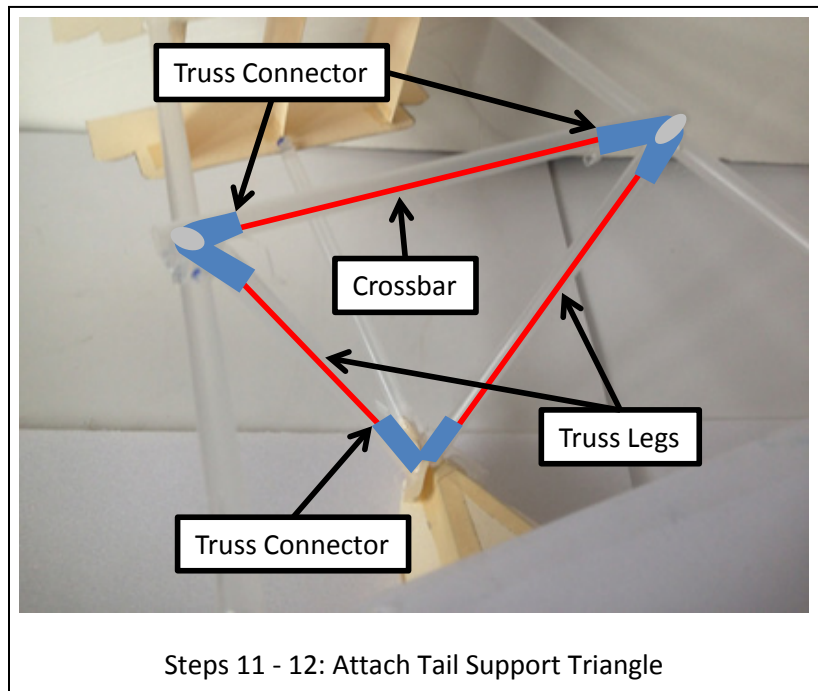
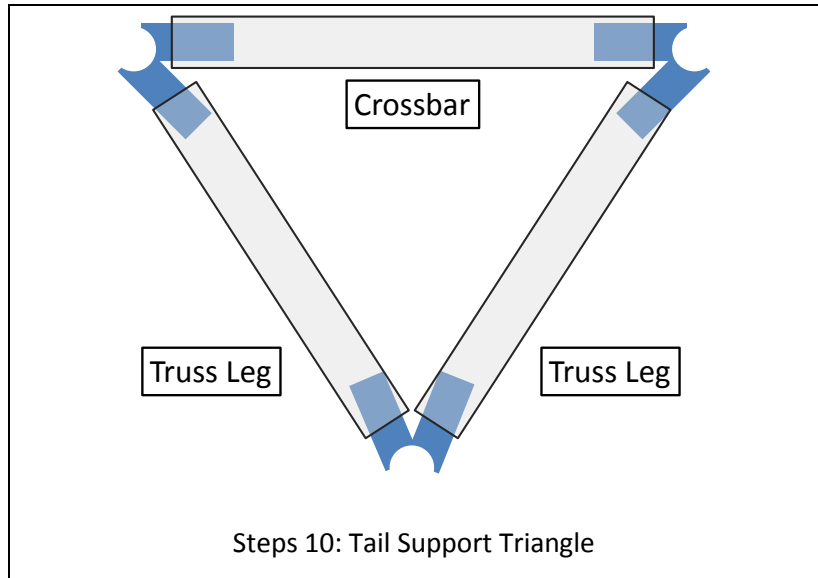
Steps 6 - 8: Place the Wing-to-Tail Booms and Hull-to-Tail Boom

- 6) There are boxes marked by dotted lines on the *trailing edge* of the Upper Wing and the *leading edge* of the Upper Horizontal Tail. Insert these areas of the Upper Wing and Upper Horizontal Tail into the slits of the Hull-to-Tail Booms.
- 7) Insert Lower Horizontal Tail into slit cut in Hull-to-Tail Boom. Tape in place.
- 8) Align the Tail by sliding the Wing and Tail on the Booms:
 - Looking from the side, the Upper Horizontal Tail is even with the Upper Wing
 - Looking from the side, the tail is level with the hull
 - Looking from the top, the Tail is centered with hull
 - Looking from the top, the Tail is straight
- 9) When you are happy with the alignment of the tail, tape or glue all of the booms securely in place.

10) Using the Crossbar, 2x Truss Legs, and 3x Truss Connectors, make the Tail Support Triangle.

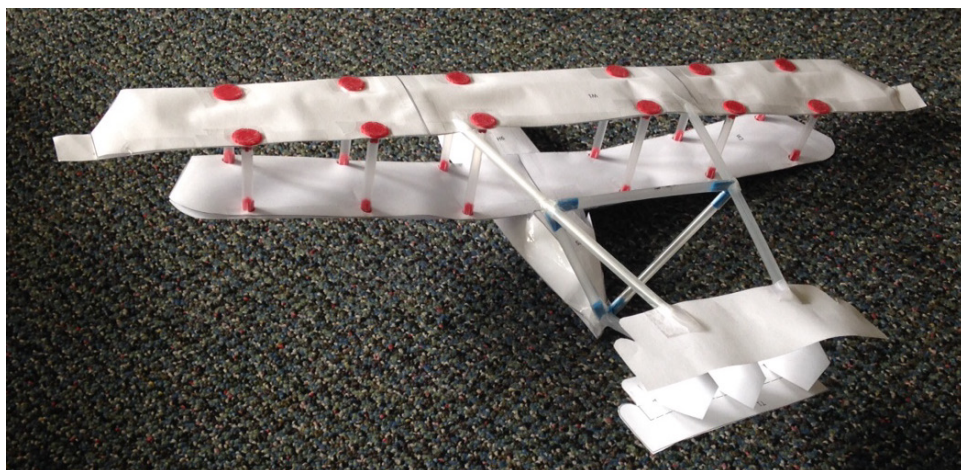
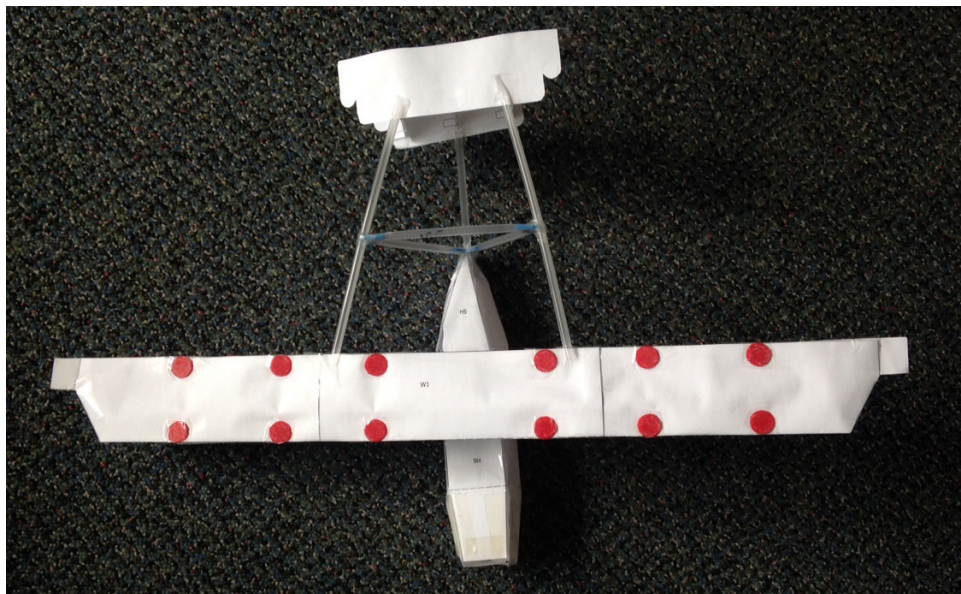
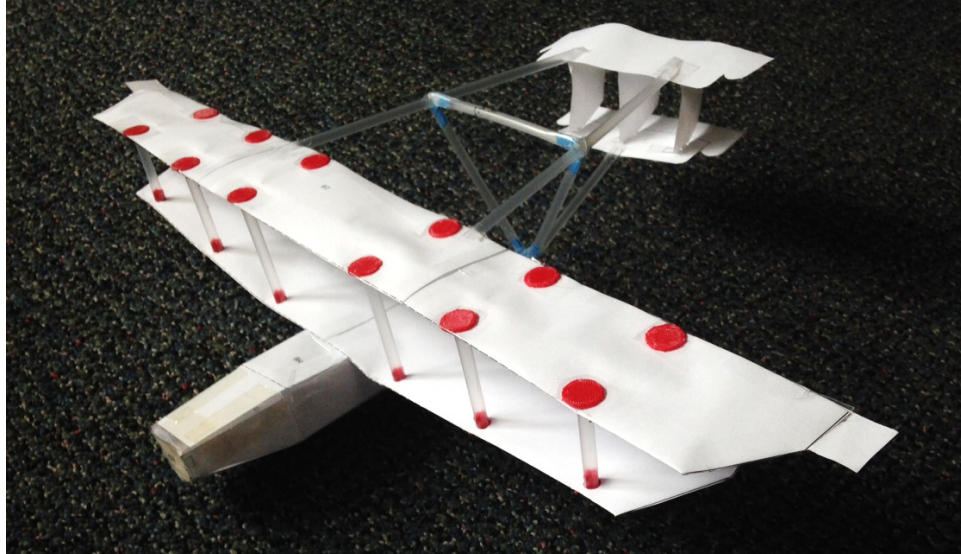
11) Attach Tail Support Triangle to the Wing-to-Tail Booms and Hull-to-Tail Boom.

12) Move Tail Support Triangle as needed to make things fit. Once you are happy, tape or glue everything securely in place.



Congratulations! You have completed the Seaplane!

Now it's time to balance and trim it to make it fly.



Balancing

The plane will not fly well, or at all, if you try and fly now. Go ahead and see what happens! Remember, you built it so you can fix anything that comes apart or breaks.

The plane probably pitched up (nose goes up) and then fell backwards. To fix this, we need to balance the plane.

Every plane is a little different, but we can start with the plane neutral and change things from there.

- 1) Place two fingers or pencil erasers on the bottom surface of the Upper Wing at the Wing Spar, near the Inner Wing Struts.
- 2) Add weight (modeling clay) to the front of the Hull (this is why we left the Front Hull Cover loose!) until the plane sits about level.
- 3) Test glide with a gentle toss straight ahead. You want the plane to glide without pitching up or diving down
- 4) Adjust as needed.
 - If the plane pitches up, add more weight
 - If the plane dives down, take some weight off
- 5) You can also adjust the angle of the Elevators (the back part of the Upper and Lower Horizontal Tails). Try bending them up or down and see what they do!

The Navy-Curtiss NC-4 Flying Boat

Name the Parts of the Real NC-4!

