

## Airplane Design, Construction, and Flight

Supplemental material to replace the "Procedure" instructions found on page 13 of the current Utah State approved **TLC** activity

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June 2001

## **Procedure:**

Now that you have learned the principles of flight and the parts of the airplane, it is time to design and build an airplane. If you follow the steps below you should be able to get your airplane to fly.

- Find pictures of an airplane (the public library has airplane magazines you may copy) that you would like to build. Notice that there are many sizes and shapes of airplanes; all will work for this activity except the Delta wing (explanation in class discussion). You should find pictures that look at the airplane directly from the side and the top so you can see the true size and shape of the parts. Look carefully at your airplane pictures. Compare the size of the wings to the size of the fuselage. Look also at the placement of the wings.
- 2. Get a piece of graph paper and fold it to match the size of the styrofoam tray that we will use to make the parts for your airplane  $(7 \frac{1}{2} \times 9 \frac{1}{2})$ .
- 3. Draw the fuselage shape on the graph paper. The nose must touch one edge of the paper and the tail must touch the opposite edge along the  $9\frac{1}{2}$  side of the paper. Count the number of squares inside of the fuselage (this is the surfaced area).
- 4. Draw the main wing (in one piece) along the other long edge of the graph paper. The surface area of the wing (the number of squares inside the wing design) should equal or be greater than the surface area of the fuselage.
- 5. Draw the stabilizer wing in the space between the fuselage and the main wing. Look at your pictures again and compare the stabilizer wing to the main wing to determine its (the stabilizer) size.
- 6. Mark the location for the main wing and the stabilizer wing on the fuselage. When you build your airplane, the two wings should be parallel to each other. For best results, the main wing should be in the front 1/4 to ½ of the fuselage and you should try not to have any thin areas that may break easily.
- 7. When you are finished drawing the parts of your airplane and you have double checked the size and shape of each part, cut them out of the paper and trace them onto the smooth side of the styrofoam.
- 8. Use a pair of scissors to cut the airplane parts out of the styrofoam.
- 9. Get a small piece of sandpaper and smooth <u>all</u> edges of the parts you just cut out.
- 10. Form the main wing into an airfoil shape by pinching and bending along the leading edge and then the trailing edge. Use the sandpaper to sand some of the trailing edge away and

to round the leading edge. Show your teacher before you move on to the next step.

- 11. Look at the end of your wing and notice the curve that you have formed. Trace or draw that same curve on the fuselage where you want the wing to pass through. Use a utility knife to carefully cut a curved slot through the foam—be careful to remove only enough foam so the wing can pass through the fuselage <u>snugly</u>
- 12. The stabilizer wing does not need to be formed into an airfoil, but it does need all edges rounded and smooth. Locate and cut a slot for the stabilizer in the same way as you did for the main wing.
- 13. Assemble you airplane by carefully passing the wings through the slots you just made. You may want to mark the center (tip to tip) of your wings to make assembly easier. You will be disappointed if you try to fly your airplane now; there is still some very important steps to complete.
- 14. Balance your airplane—there should never be any balancing weights behind the center of the main wing.
- 15. Make the elevator flap in the stabilizer wing by making a single cut (½" long) into the trailing edge about 1/4" left or right of the fin. The entire trailing edge from the cut out to the tip will be gently bent up or down as needed to control the airplane flight.
- 16. Test fly your airplane. You will probably need to make small adjustments on the elevator flaps (bend up if your airplane nosedives or bend down if your airplane goes up into a stall).

## **Evaluation:**

+	(full credit)	The airplane demonstrates lift and control while gliding to a smooth landing
<b>√</b>	(80% credit)	The airplane shows lift without control; usually the airplane flies a little but the flight ends in a posedive or a flutter
-	(65% credit)	The airplane shows limited effort and flies poorly; wings to small or loose and wobbly, little or no airfoil, poor balancing, edges rough and square.
Check	List: The fo airplan	llowing is a list of things to think about and possibly change if your e does not demonstrate lift and control.

- 1. Are the parts of your airplane large enough? Refer to # 3, 4, 5 above.
- 2. Is the surface area of the main wing the same as or greater than the surface area of the fuselage? Refer to # 3, 4 above.
- 3. Did you form your main wing into an airfoil shape? Refer to # 10, 11 above.
- 4. Is the main wing and stabilizer wing parallel? Refer to # 6 above.

- 5.
- Double check the balance of your airplane. Have you adjusted the elevator flaps into many various positions as you test flew your airplane? Refer to #15, 16 above. Have you smoothed and rounded all edges? Refer to # 9, 10, 12 above. 6.
- 7.