

## Wright Brothers 1902 Glider

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The Wright Brothers' 1902 Glider was their third unpowered aircraft. It was flown repeatedly at Kitty Hawk during 1902 as a kite and as a piloted glider. The brothers used this aircraft to solve some of the problems encountered with the 1901 Glider. They also used it to develop their piloting skills, because this was the first aircraft in the world that had active controls for all three axes: roll, pitch, and yaw.

The 1902 aircraft had two wings and an elevator-stabilizer mounted in the front, like the 1901 aircraft. It had a 32-foot wingspan, a 5-foot chord, and 5 feet between the wings. Without the pilot, it weighed about 120 pounds. As before, the pilot lies on the bottom wing and controls the roll of the aircraft by warping the wing shape. On the 1902 aircraft, however, and on all flyers through 1905, the warping was controlled by a control device called a "hip cradle," instead of the pedals that were used on the 1900 and 1901 aircraft.

There were other major differences between this aircraft and its predecessors as well. Data from the 1901 wind tunnel experiments showed that a longer, thinner wing gave less drag and a better lift-to-drag (L/D) ratio, so the aspect ratio (ratio of wingspan to wing chord or width) was changed from 3:1 on the 1901 aircraft to 6:1 on the 1902 aircraft. To try to solve the problem of adverse yaw from the 1901 Glider, two 6-foot rudders were added to the rear of the craft.

Test flights went better than in 1901, but occasionally, the glider would spin out of control on recovering from a turn at low speed. Lying awake one night, Orville concluded that the rudder was acting like a vertical wing, in which turning generated an angle of attack, and thus, an unwanted force in the wrong direction. To correct this, a single, movable rudder was attached at the rear and connected to the wing-warping.

Now perfected, the glider worked beautifully, keeping the nose of the aircraft pointed into the curved flight path. On the 1902 aircraft, the pilot could also change the angle of the elevator to control the up and down position, or pitch, of the nose of the aircraft. For the first time in history, a craft could be controlled in three dimensions. With this new aircraft, the brothers completed gliding flights of over 650 feet.

At the end of 1902, all that remained for the first successful airplane was the development of the propulsion system. During the following winter and spring, the brothers built their own small engine from scratch and perfected their own propeller design for the 1903 flyer.





# Wright Brothers 1902 Glider Model Instructions

## Designed by

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## Materials

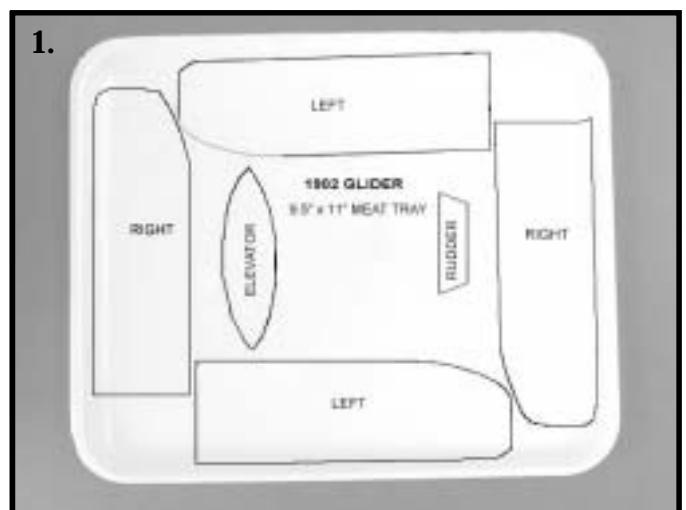
- One or two clean Styrofoam meat trays, at least 9 inches (23 centimeters) by 11 inches (28 centimeters), preferably white
- 30 to 35 toothpicks
- Low-temperature glue gun
- Scissors
- Hobby knife, razor utility knife, or single-edge razor blade (adult help here)
- Cardboard or board to cut on
- Ultrafine-tip black marker
- Ruler
- Emery board
- Manila file folder
- Small plastic toy army soldiers, about 2 inches (5 centimeters) tall (optional)

## General Instructions

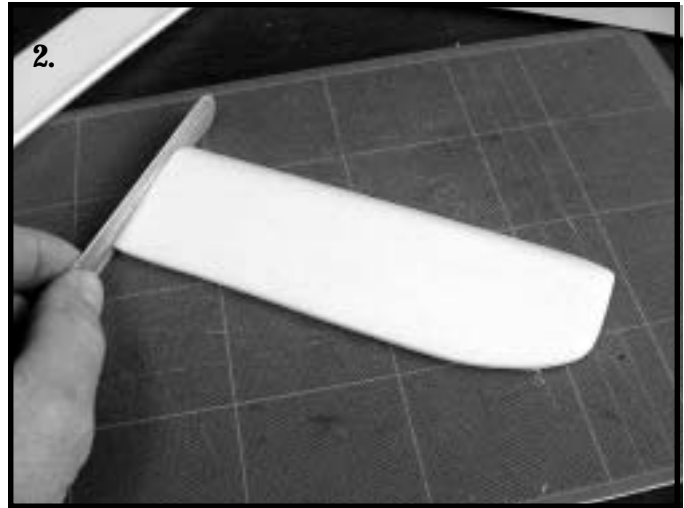
- Use scissors to cut out all three templates on the heavy lines of the 1902 Glider template (found in the back of this book).
- Do all hobby knife or razor blade cutting on the board or cardboard to protect your working surface.
- The finished model is for display only; it is not meant to fly.

## Procedure

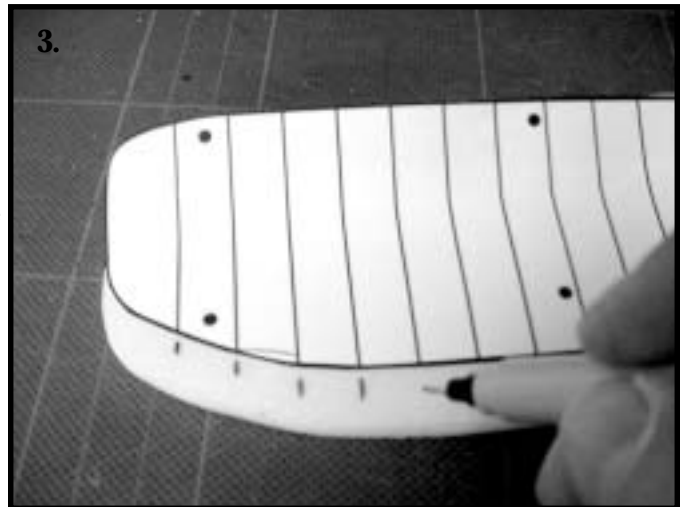
1. Carefully trace the wing and elevator shapes on the inside of the Styrofoam tray as shown. Be sure the front edges of the wings go about two-thirds of the way up the curved sides of the tray. Check the bottom of the tray and avoid any logo found there. You may need two trays. Cut out the wings and elevator with the hobby knife or scissors.



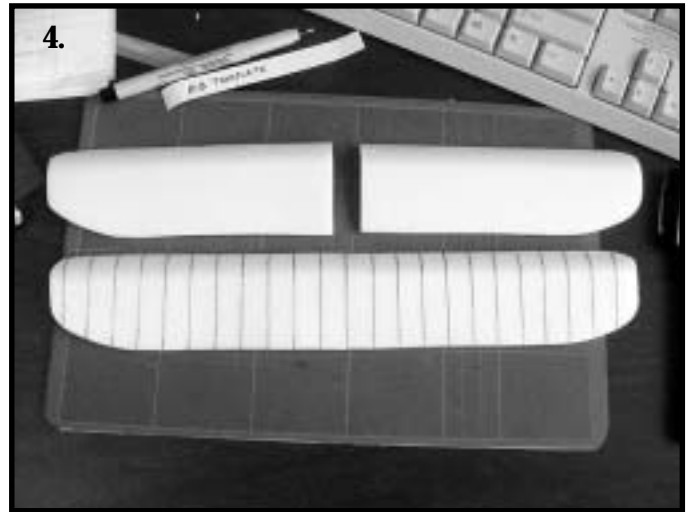
2. Use the emery board to smooth the edges and sand off the pen lines. Make sure that the two halves of the upper wing are flat where they will be joined, as shown at the right.



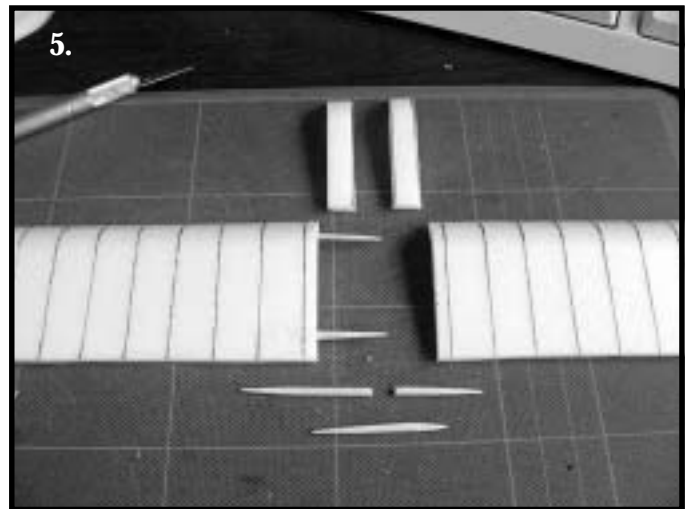
3. Using the templates as a guide, mark the locations of the rib lines on the tops and bottoms of the wing and elevator sections with the ultrafine-tip black marker. Make two sets of marks, one on each edge. Connect the marks to make the rib lines. Make a rib template from a manila folder to draw the rib lines (so the end of the template can be bent to conform to the rounded shape of the Styrofoam).



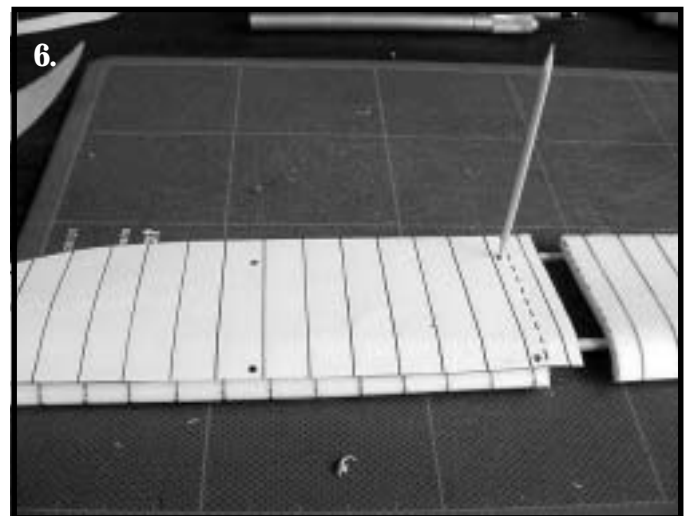
4. Place glue on the flat edge of the upper wing halves and join them as shown.



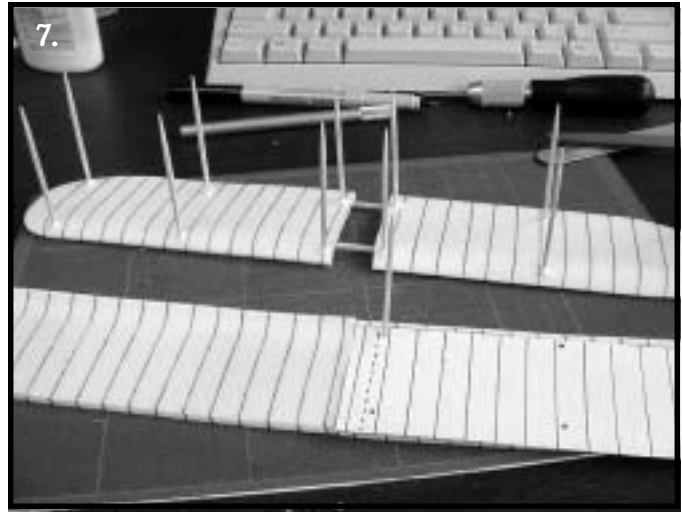
5. Cut off the parts of the lower left and right wing only as shown by the dotted line on the template. Cut a toothpick in half and sharpen the cut ends. Dip the ends in glue and stick them in the cut edges to join the lower wing halves, leaving a .6-inch (1.5-centimeter) gap between the halves. (If the Styrofoam is thin, glue the toothpicks to the underside of the wing instead.)



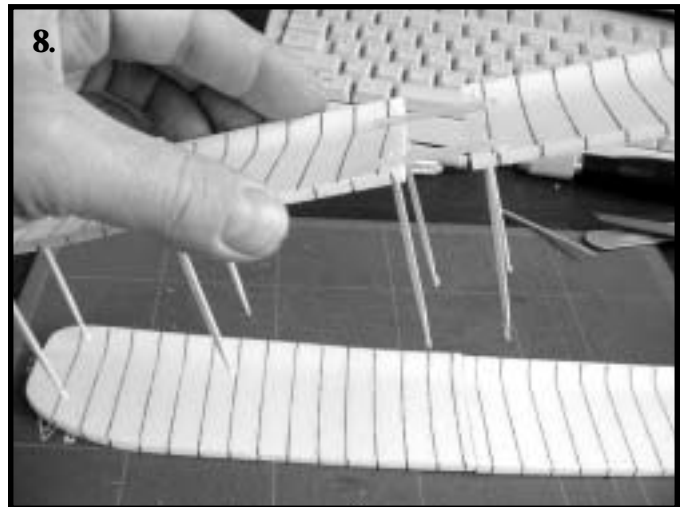
6. Use the wing template and a sharp toothpick to mark the holes for the spars on the top surface of the lower wing (the front edge should curve down as shown) and the bottom surface of the upper wing.



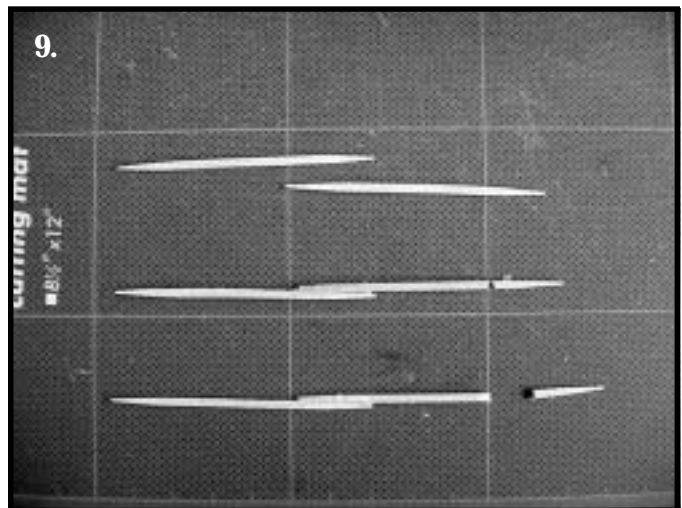
7. Dip toothpicks in glue and insert them in the spar holes now marked in the lower wing. Try not to push them all the way through the wing. Be sure they are standing up as straight as possible.



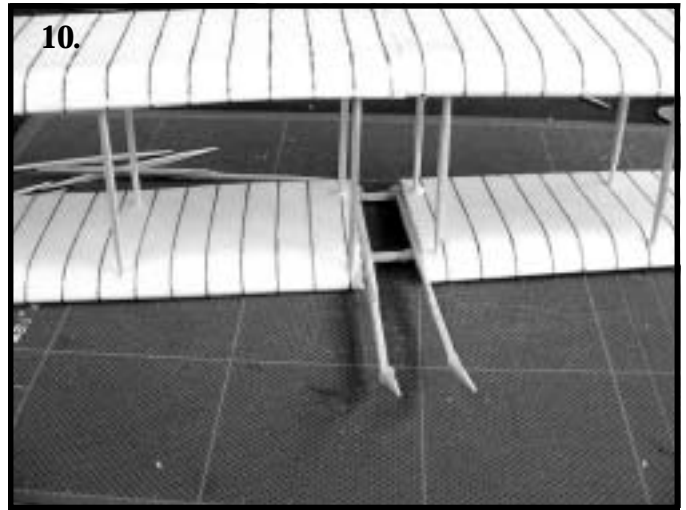
8. Now, with both the upper and lower wings upside down (the edges should be curving up at this point), insert the back row of spars into the underside of the top wing. Use the marked holes as a general guide, but keep the spars straight and evenly spaced. Put a little glue on each to keep them in place as shown in the picture. Now join the front spars to the top wing, remembering to keep them straight and fasten them with dabs of glue. This takes some effort to get everything in the right place and is easier to do with two people.



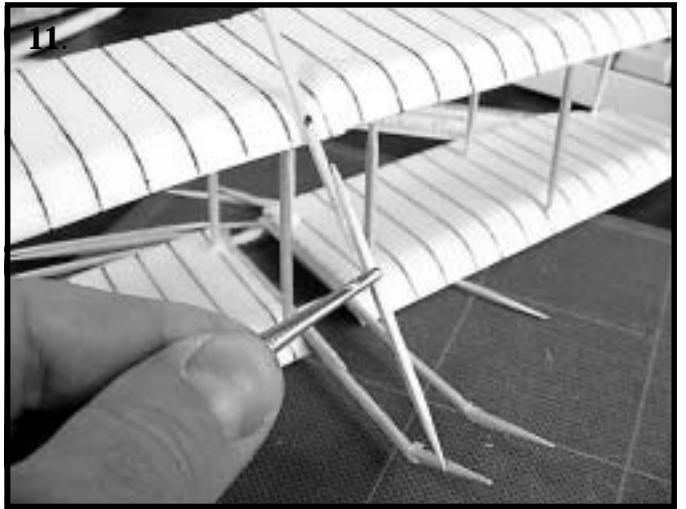
9. To make each of the two skids join two toothpicks end to end. When the glue is dry, trim them to a length of 3 inches (7.5 centimeters) and then glue the cutoff end back on at a 30-degree angle.



10. Glue the skids on either side of the opening in the lower wing so that the tips point upward. They should project out from the downward curving front surface.



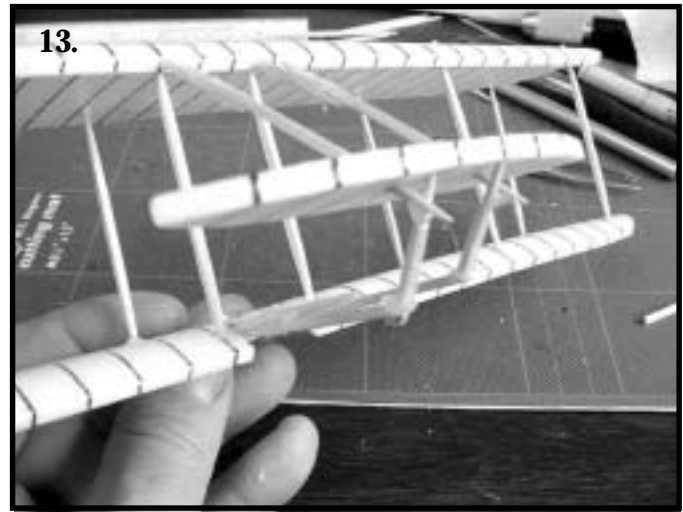
11. Cut a piece to brace across the skids and glue it at the 30-degree joint. Make two braces to go from the upper wing to the elevator by joining two toothpicks end to end and side by side to form a longer toothpick, and then mark them to the correct length by holding them between the upper wing and the skid, as shown. Allow enough to stick into the upper wing, cut off the excess, and then sharpen the cut end. (If the Styrofoam is thin, do not sharpen the cut end.)



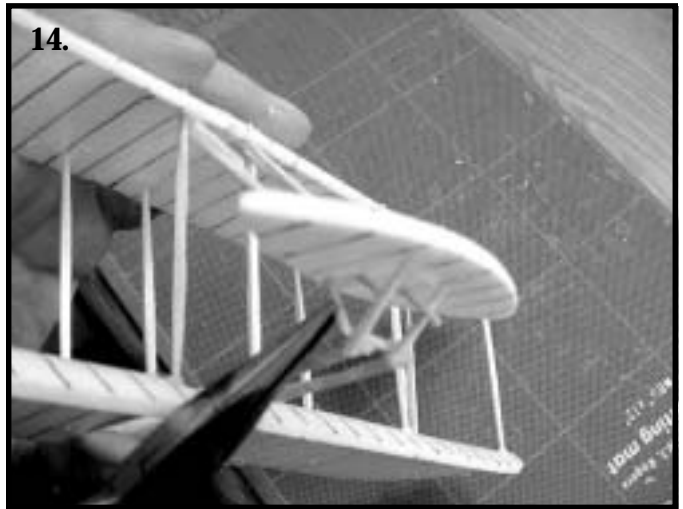
12. Push the ends of the uprights through the center of the elevator at an angle back toward the wing. Put glue on the top end of the upper braces and push them into the edge of the upper wing. (If the Styrofoam is thin, glue the ends of the uprights underneath the front edge of the upper wing.)



13. Now glue the lower end of the brace that sticks through the elevator to the upturned part of the skid in a way that makes the elevator level. Add a crossbar across the skids at the joint where the skids turn up at the 30-degree angle.



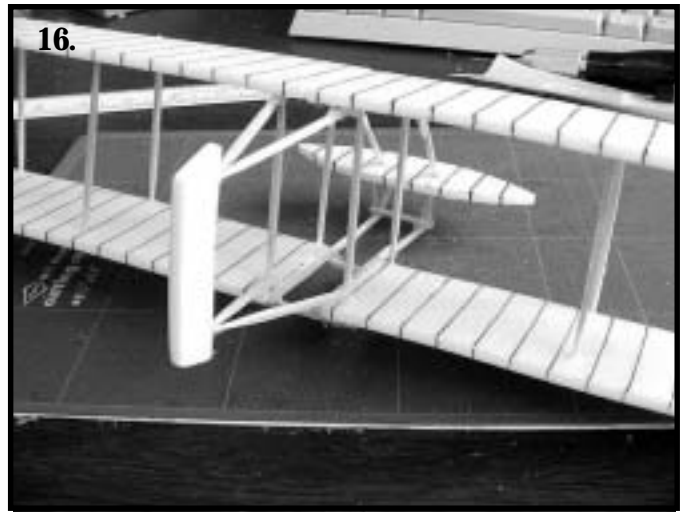
14. Cut two small pieces of toothpick long enough to go from the 30-degree joint to the rear of the underside of the elevator, and glue them in place. You may need to use tweezers or long-nosed pliers.



15. To attach the rudder, cut four toothpicks into 2-inch (5.5-centimeter) lengths, and stick the sharp ends into the long edge of the rudder, two on the top and two on the bottom so they form a "V" shape, as shown. The distance between the two legs of the V should be 3/4 inch (1.8 centimeters). Turn the glider over and glue the top two braces to the underside of the upper wing.



16. Turn the glider right side up and glue the bottom two rudder braces to either side of the opening in the lower wing. This finishes the glider.



17. (Optional) You can make the figures of Wilbur and Orville Wright by swapping and gluing parts of plastic army soldiers. To obtain the desired poses, arms and legs can be removed and some from other soldiers glued in their place. Guns and helmets should be trimmed away using a hobby knife and the figure arms and legs can be shaped, swapped, or repositioned to fit and glued on. Five-minute epoxy works best for this. The picture to the right shows how to make a pilot lay on the wing. The original soldiers on the left were transformed into the figures of Wilbur and Orville Wright on the right.

