

Chippy Autogyro



Thank you for downloading the Chippy autogyro plans. This model is designed with the beginner in mind but even the experienced autogyro pilot should find the model a joy to fly. Special attention should be paid to the angles on the plans such as the down thrust and the angle of the mast. Any deviation from important details in the plans no matter how small can result in an unstable or totally unflyable model.

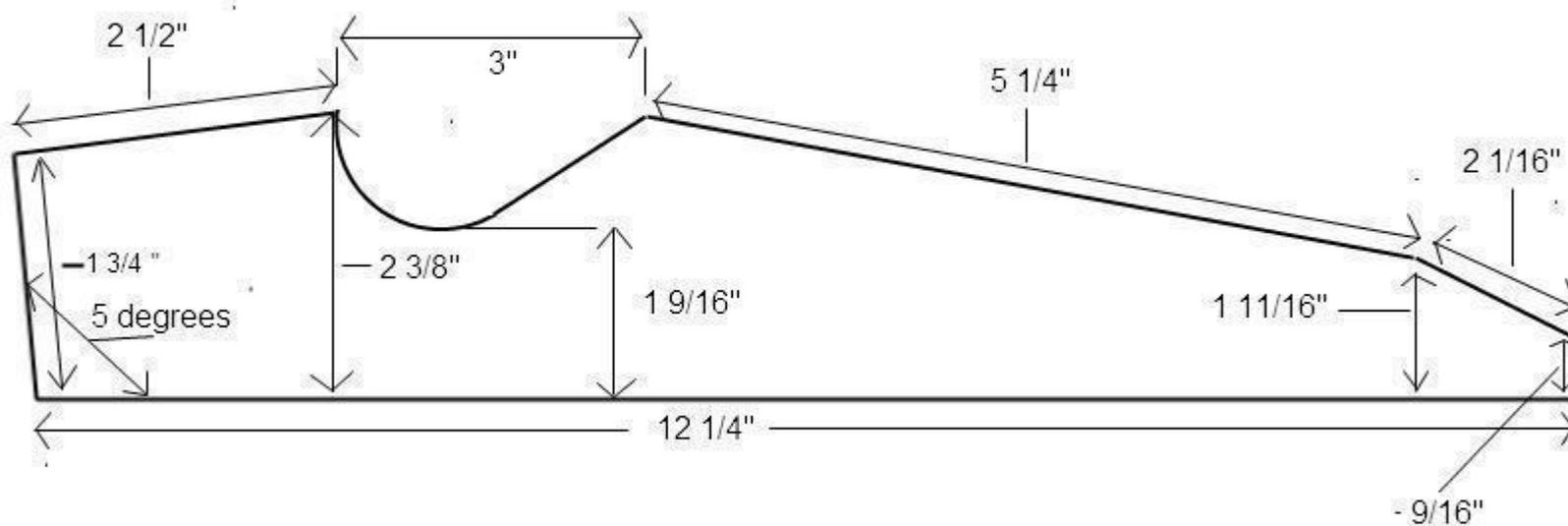
One of the hardest parts of flying a new autogyro is getting the model trimmed out while learning to fly at the same time. If you are a newbie to rc autogyros it's highly recommended you have an experienced autogyro pilot on hand to help you with those first few flights. An electronic flight stabilizer unit can be added. This will reduce pilot workload to a minimum and mask an out of trim condition. A link will be added as you near completion on where to purchase and how to setup the stabilizer unit.

Building the fuselage

Start out by copying the following dimensions onto your foam board. These will be the fuselage sides. Careful attention should be made at the front of the fuselage. The angle should be 5 degrees for motor downthrust. After you have this cut out lay it back down on the board and trace another one so you have an exact replica.

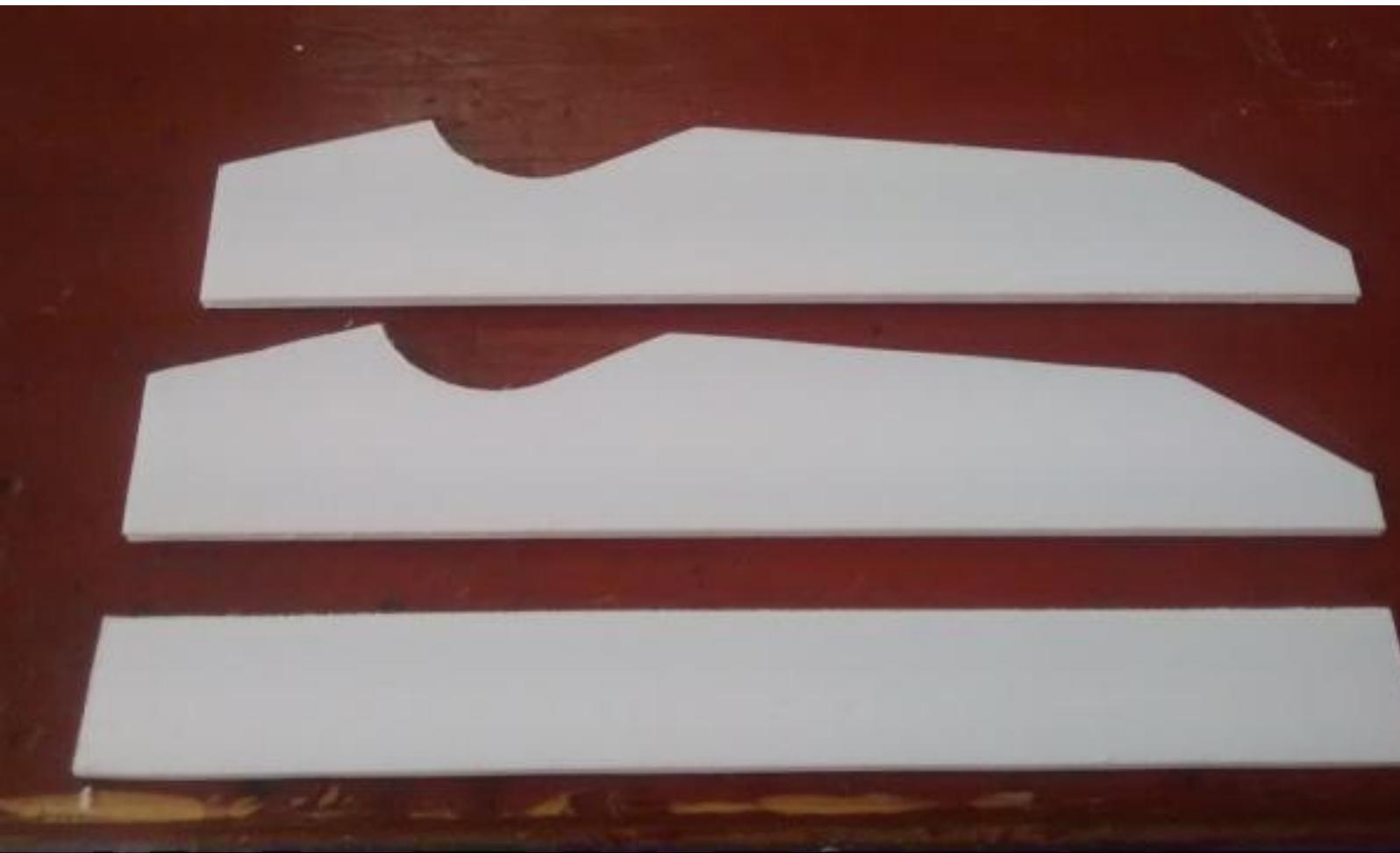
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Material: Dollar tree foam board "adams radi board" Can be substituted with 3/16" thickness foam of the same strength.



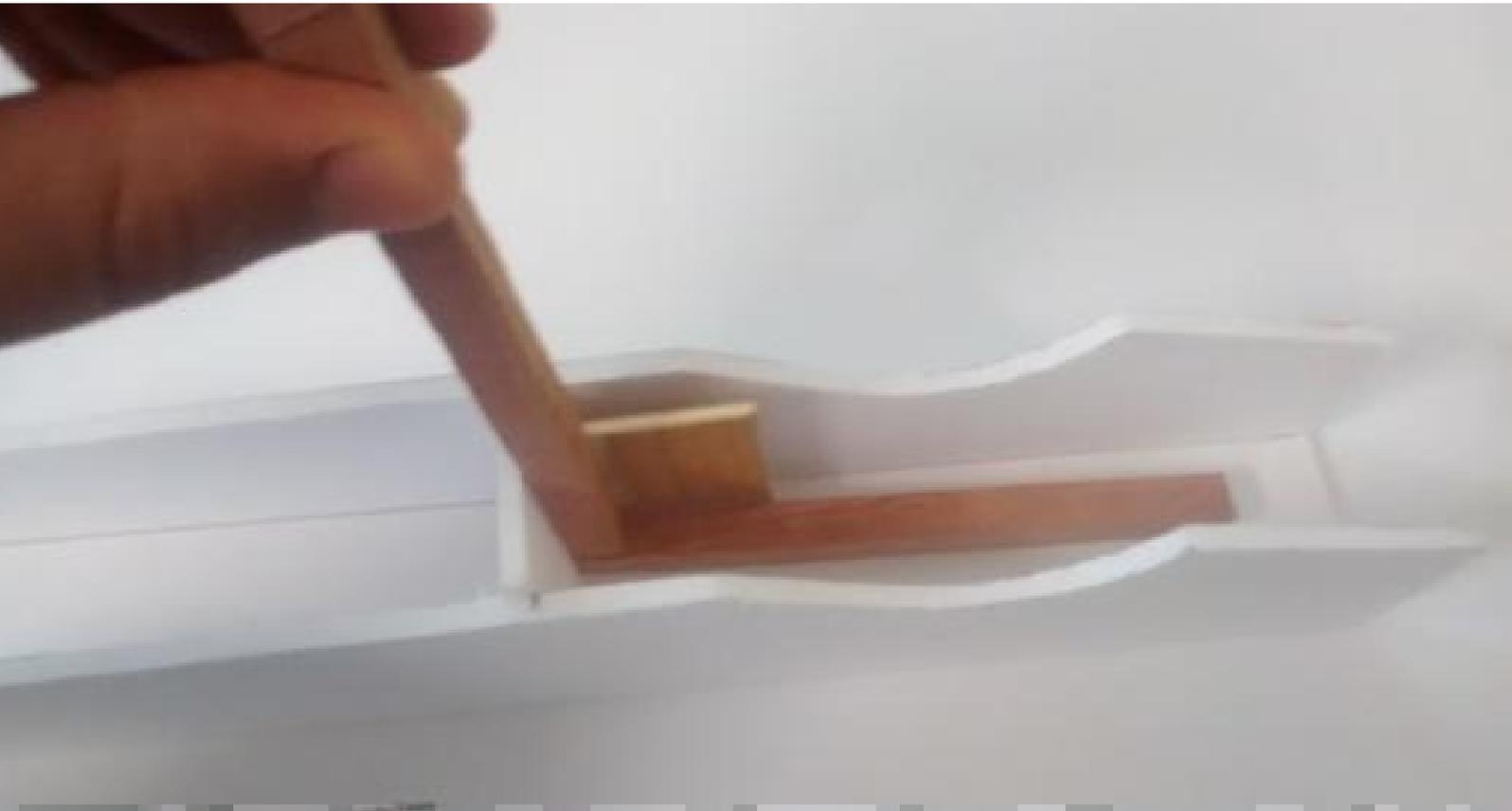
After you have your two fuselage sides cut out set them aside and cut out another piece 12 1/4" long by 1 1/2" wide. This will be the bottom of the fuselage. so far this is what you should have.

Lay a bead of hot glue along the bottom of one of your fuselage sides and butt it against the fuselage bottom piece making sure the side is at a 90 degree angle to the bottom. Repeat the process for the other side.





Cut out a piece of foam 2 1/8" x 1 1/2" and a piece of plywood at the same dimensions. Measure 7 1/2" back from the front of the fuselage and place a mark. Glue the foam in place just behind the mark you made making sure the foam is angled back 10 degrees. A simple jig can be made from scrap wood to insure your mast sits at 10 degrees. This is a critical step, IF you have too much rear tilt the model may not fly correctly. If you have to err on one side less tilt is better than more.



Glue the plywood plate you cut earlier into place onto the front surface of the mast support you just glued in. Use a good amount of hot glue in these steps to insure your mast doesn't come loose in a crash. Cut another piece of foam 2 3/8" x 1 1/2" and glue it in place at an angle as shown, the angle is not critical this will just be to add strenth.



Looking at the rear of the fuselage place a mark $2\frac{1}{8}$ " from the back edge. Now take a piece of your $\frac{3}{8}$ " x $\frac{3}{8}$ " spruce stock which should be exactly 10" long and glue your tailboom in place using the mark you placed as a guide. Care should be taken to insure the tailboom isn't crooked when staring down the fuselage.

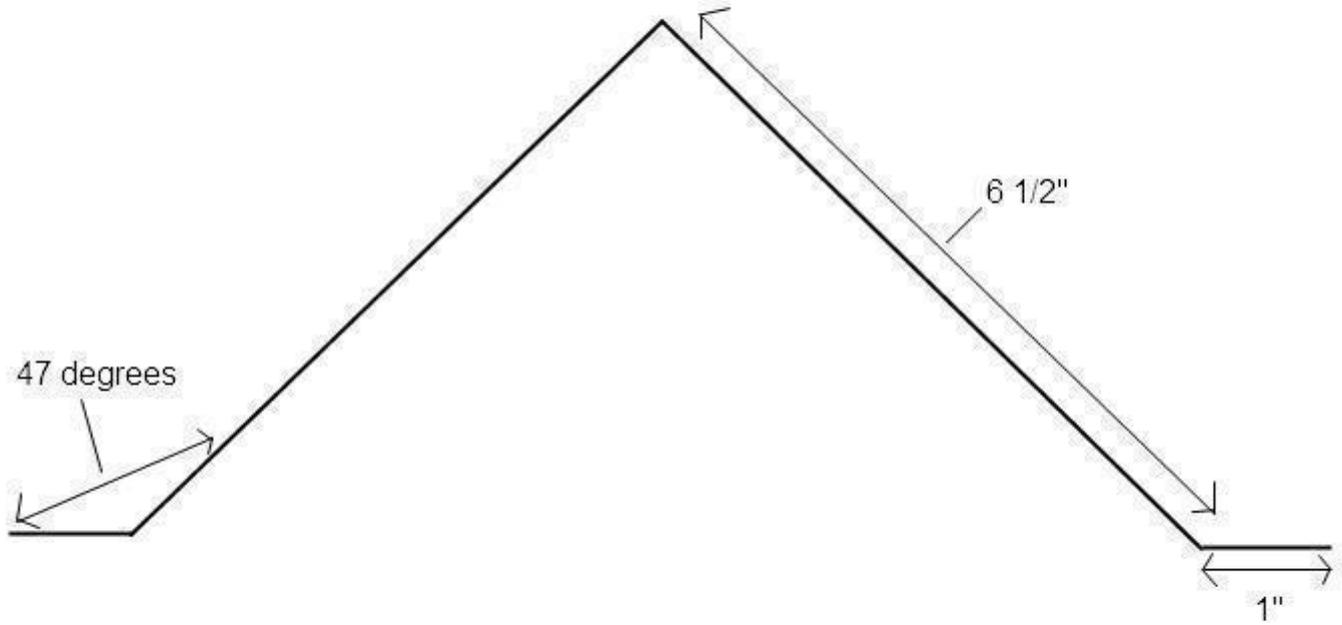


Cut out another piece of foam $2\frac{1}{8}$ " x $1\frac{1}{2}$ " and glue it down over top of the tailboom. Be sure there is good glue contact between the foam and wood and on the sides.



Making the Landing gear

Take your 1/8" piece of piano wire and shape it according to this drawing.

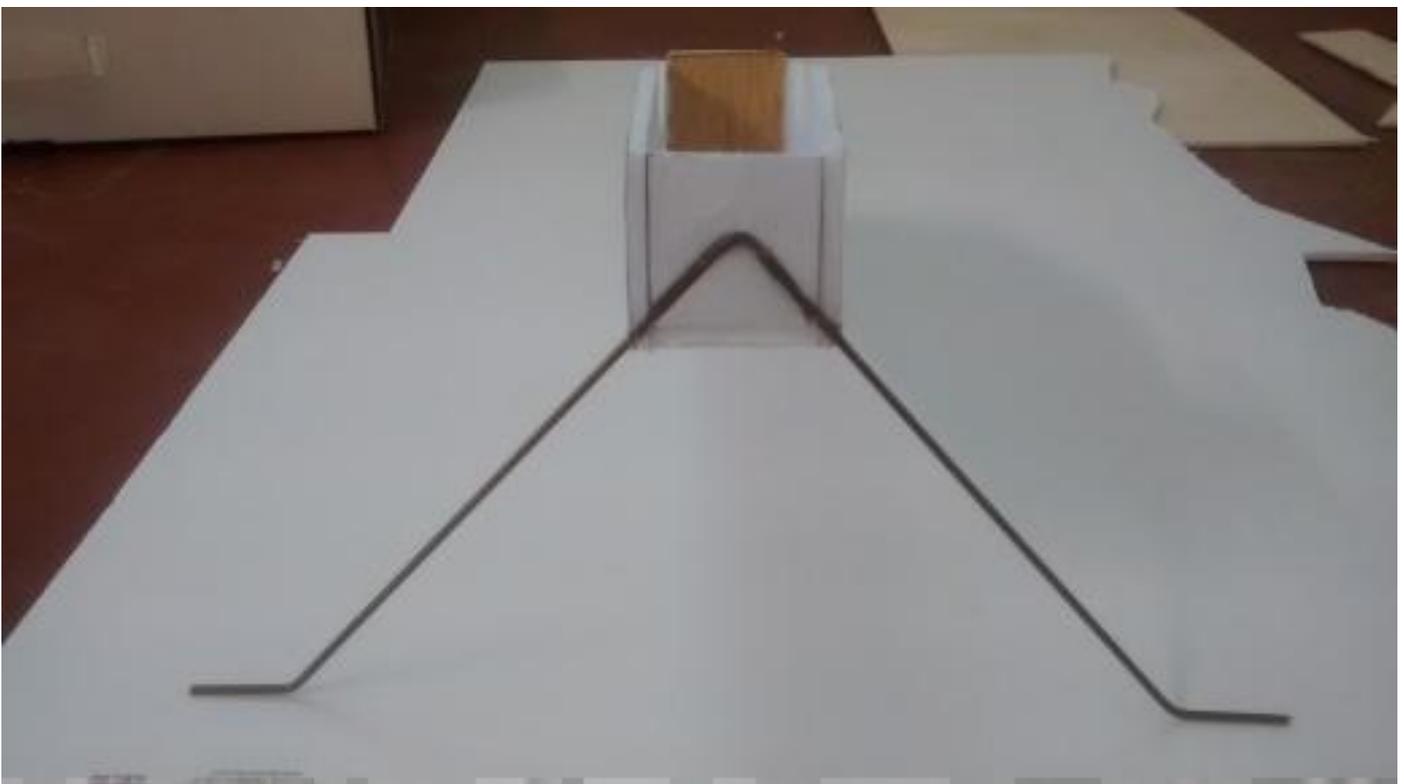


Cut out a piece of foam 1 1/2" x 1 9/16" and glue it in the nose as pictured.

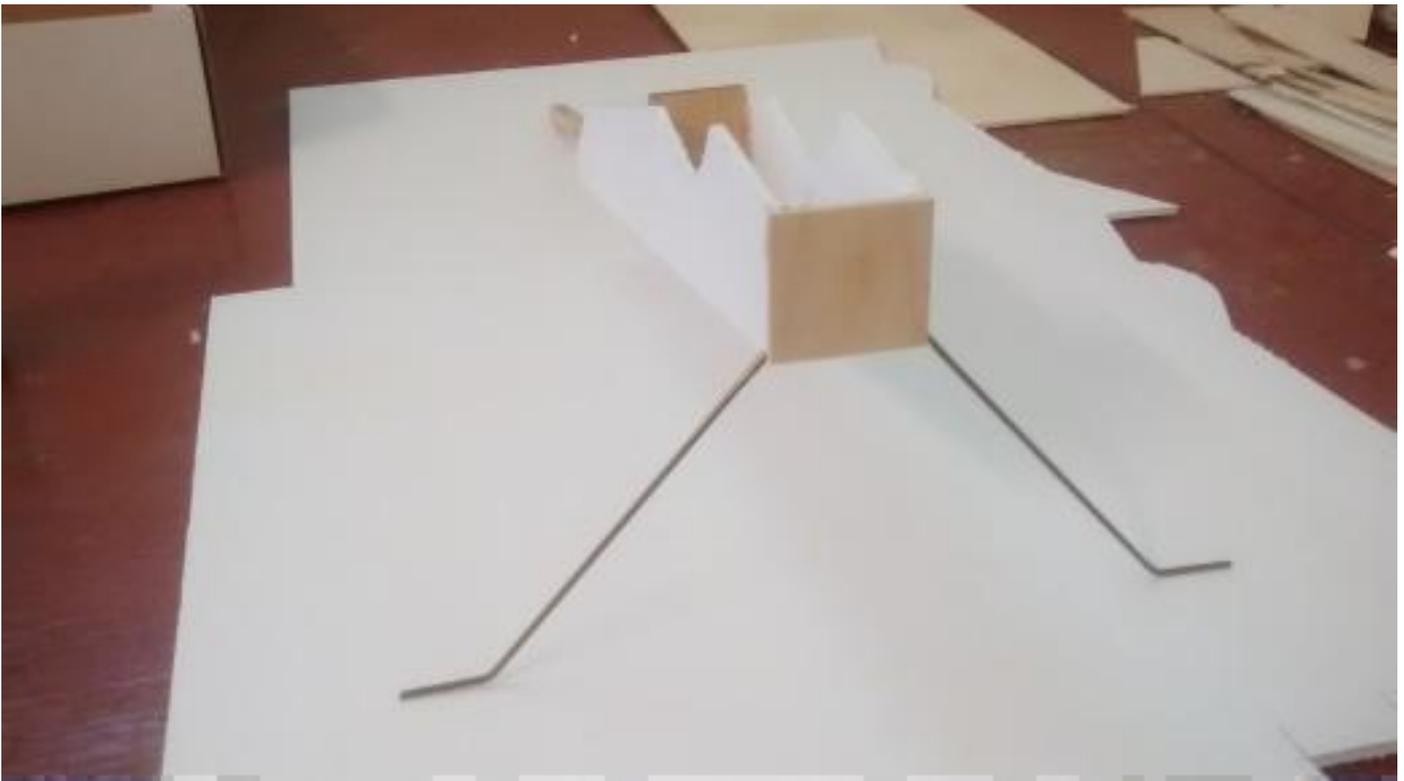


Hold the landing gear up to the firewall making sure the gear and fuselage are level and with a firm pressure push against the wire leaving an indentation in the foam. Take your razor knife and cut into the first layer of paper careful not to go all the way through. Drag the tip of the landing gear through the channel you just cut. If you did it correctly the gear should now easily rest inside the channel. Do not neglect this step, the gear should easily go into the groove and should be flush with the foam. When you are happy with the fit lay a small bead of glue into the groove and press the gear into place. Take a scrap piece of foam and wipe away the excess glue. After the gear is glued into place lay another bead of glue over the joint and wipe away the excess glue.



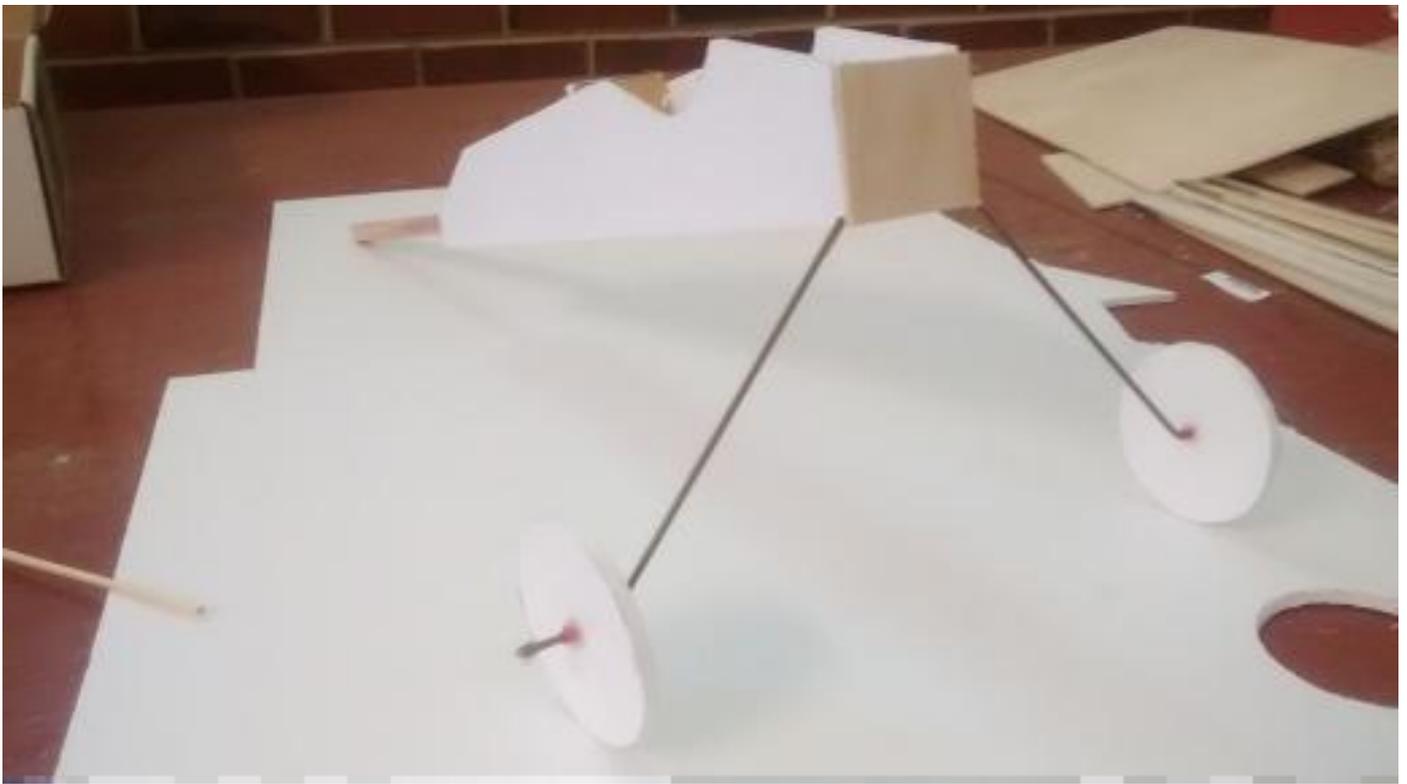


From your plywood cut a piece measuring $1 \frac{15}{16}$ " x $1 \frac{3}{4}$ " and liberally glue it in place over the gear as shown. The motor will later be screwed down to this plywood.



A pair of light weight wheels can be made as follows. Drill out the center of a spray paint top and trace out your wheels. Make the wheel hub out of a piece of coffee stirrer. Reinforce the outside of the wheel with a thin layer of hot glue smeared around the wheel with a scrap piece of foam.





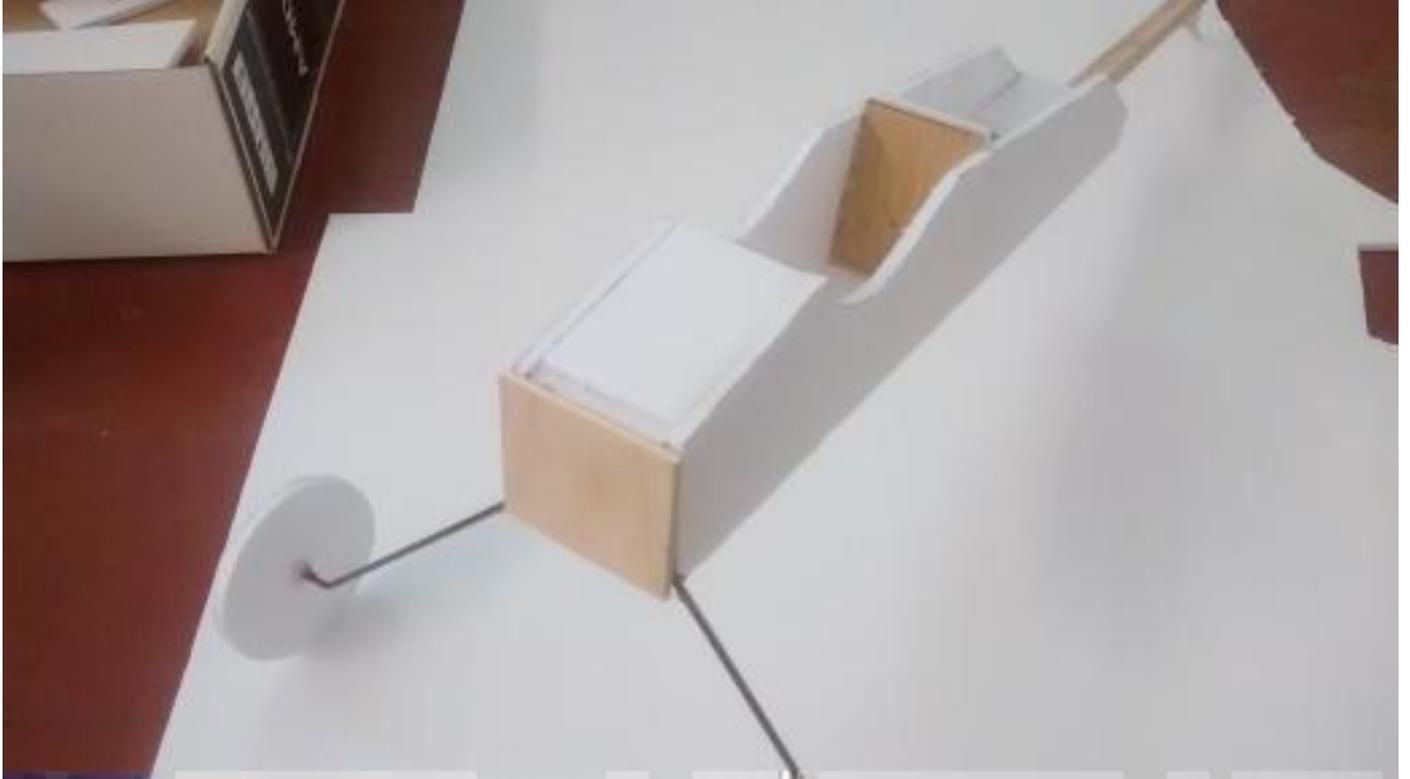
The tailskid can be made with a scrap piece of foam and part of a bamboo skewer. The dimensions aren't critical.



Flip the fuselage over and cut a hole big enough for your speed controller to fit through. Turn the model right side up and add a small strip of self adhesive velcro for the battery as shown.



Now we can seal up the top forward part of the fuselage. Cut a strip of foam measuring 2 1/4" x 1 1/2" and glue it in place as shown.



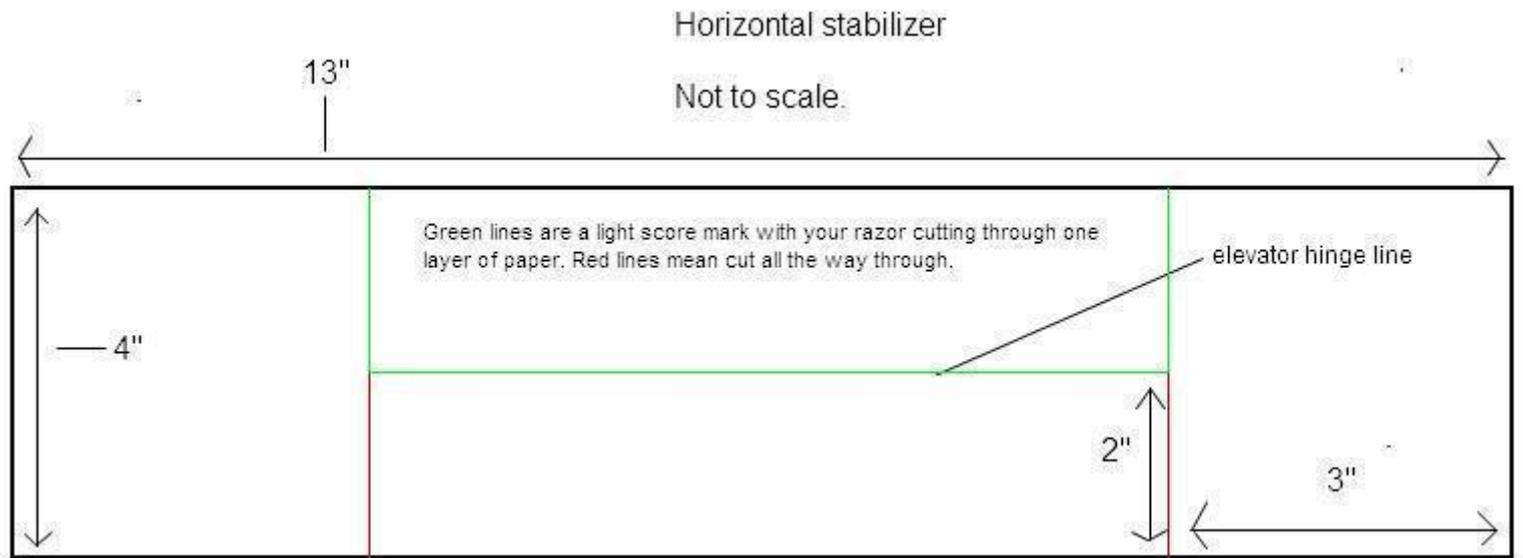
At this point we can add a few small details that really make the model pop. Of course these aren't needed for the model to fly. The windshield can be made from a small plastic drink bottle.





Building the Tail surfaces

Start off by drawing these dimensions onto your foam board. The green lines mean a light score cut and the red lines mean cut all the way through. If you did it correctly the elevator should fold open as pictured allowing you to cut a bevel for the elevator hinge. Some light sanding may be needed if the elevator isn't opening easily. After your satisfied the elevator is working properly a thin film of hot glue can be added and wiped off to reinforce the hinge. fold the tips open where you put score marks and inject hot glue into the joint while positioning the tips to the correct angle. Do not avoid this step, the upturned tips add to the stability of the model and are not just for show.





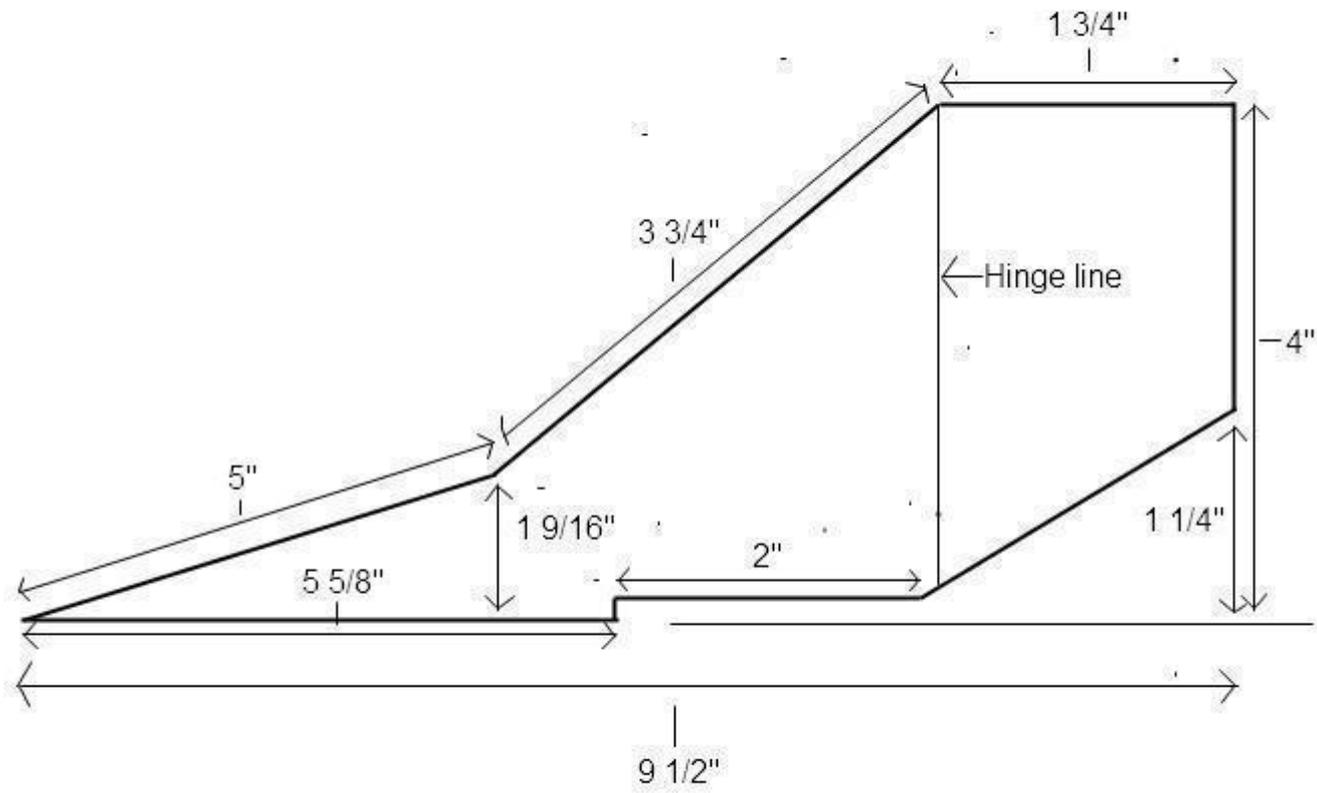


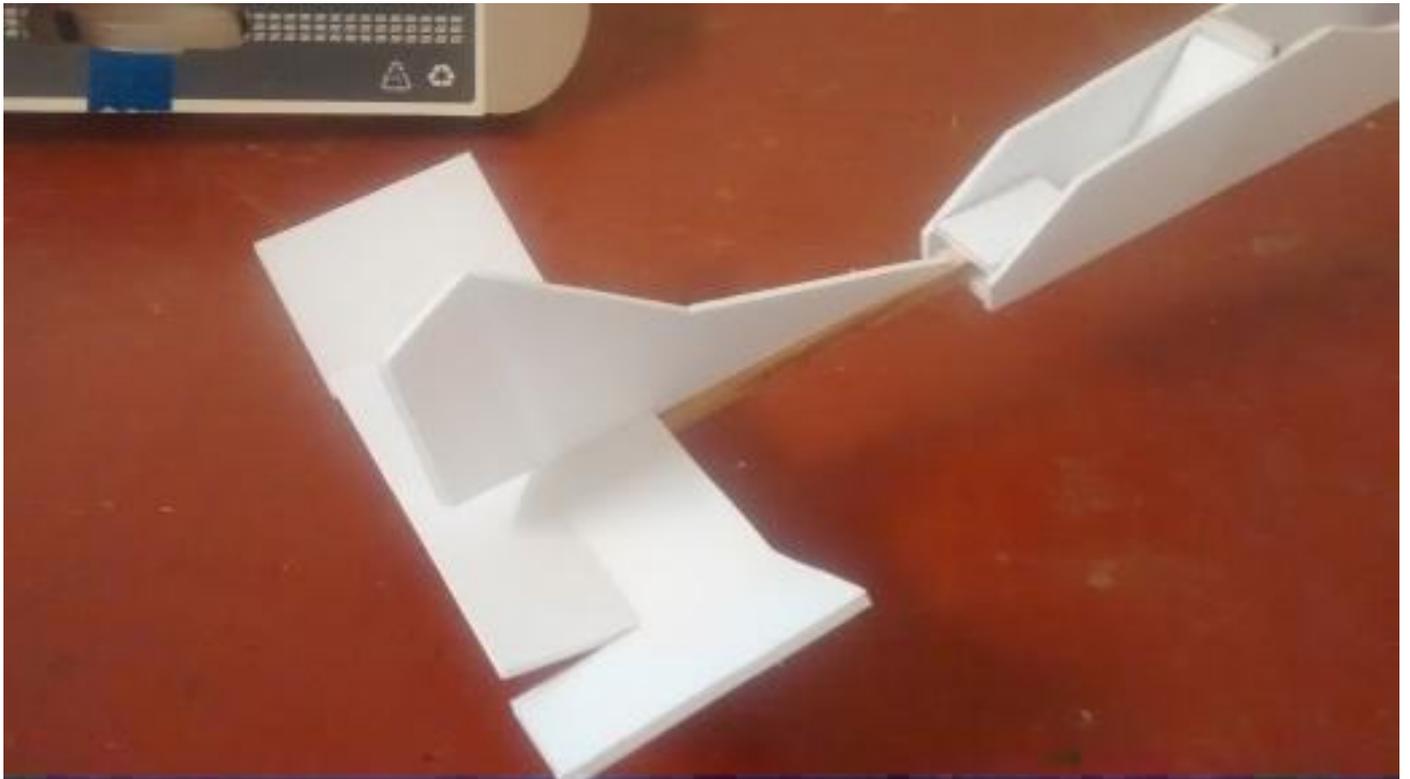
The horizontal tail can now be glued on. A line can be drawn on the bottom to help you glue the tail on straight.



Copy the following dimensions out onto your foam board to make the vertical tail surface. After you have that cut a score line where its marked "hinge line" on the drawing and then carefully fold the rudder open just like we did with the elevator on the other surface. carefully cut a bevel so we have equal deflection of the rudder and go back and reinforce the hinge with hot glue just like before. Glue the rudder on as follows.

Image not to scale.





Building the mast and rotor head

Take another piece of your $3/8 \times 3/8$ " spruce and cut it to a length of $9 \frac{5}{8}$ ". Place a mark $3/8$ " from the top and carefully drill a $1/8$ " hole in the center of the mast as pictured. Access to a drill press will be real handy here but can be done with a hand drill and a steady hand. Glue the mast to the fuselage as pictured, be sure the hole you drilled earlier is facing forward or else you will have to drill a new hole or tear the mast back off.



To make the rotor head cut a piece measuring $1/2$ " long from your $3/8 \times 3/8$ " spruce stock. A drill press is a must if your to make an accurate hole. Using a $5/32$ " drill bit, drill all the way through the center of the block you just made. Depending on the size of the bearing your using a little experimenting may be needed to find the correct size drill bit. **DO NOT DRILL ALL THE WAY THROUGH THE BLOCK**, your bearings should be a tight press fit and sit flush with the top and bottom of the block.





Cut two pieces measuring $1 \frac{7}{8}$ " from your Popsicle sticks as shown. A couple scores with a razor knife should allow you to break them cleanly. Glue these to two sides of your bearing block as shown. Now cut another length of Popsicle stick measuring $1 \frac{9}{16}$ ". $\frac{1}{4}$ " from one edge drill a small diameter hole just big enough for your piano rod to fit through, this will be the control horn that allows the rotor to tilt left and right.



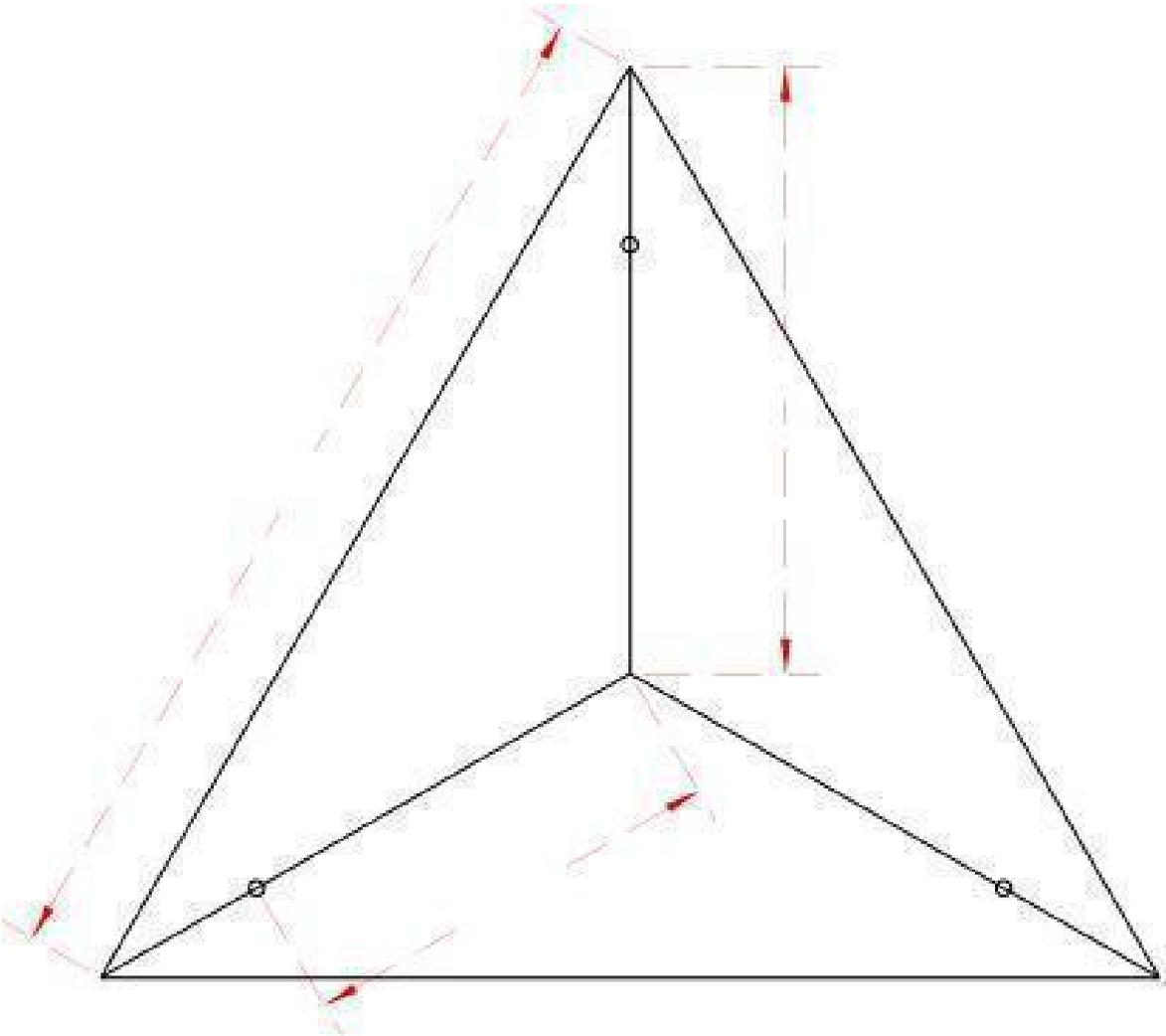


Now we can add the hardware to our rotorhead. Take one of your m3x28mm bolts and insert it through the bearings from the bottom. Do not add any washers in this step, it will only cause binding against the bearings. Add a m3 locknut to this bolt and tighten it down until there is very little vertical slop but there shouldn't be any binding against the bearings, make sure this bolt can rotate freely.

Place a mark $\frac{7}{16}$ " from the bottom of the rotor head as shown and drill a $\frac{1}{8}$ " hole through both sides of the Popsicle sticks.



To make the rotor head plate which the blades mount to you will need to print the following image out on your printer at 100% scale. Cut this Triangle out and then trace it onto your plywood along with the placement of the bolt holes. The center and the three outer holes are 1/8". Be sure the placement of the bolt holes are accurate, if they are out of alignment there will be a vibration in the model.



At this point we can mount our rotor head plate on the rotor head itself. one m3 washer goes on first, then the rotor head plate, another m3 washer and finally we can lock it down with a m3 locknut. The rotorhead should spin freely.

Now we can bolt this assembly onto the mast on our fuselage. Take another m3x28mm bolt and add a m3 washer then insert this bolt through the rotor head and the hole in the top of the mast as shown, add another m3 washer and then tighten the assembly down with a m3 locknut. The head should now pivot freely left and right without binding.





Making the Rotor Blades

The rotor blades are the heart of the autogyro, a little care in their construction will go a long way in a good flying model. The blades are made from dollar tree foam with a bamboo skewer leading edge and are covered in packing tape. They are surprisingly durable.

You will need a good sharp razor blade and a sanding block. A simple sanding block can be made from a piece of 100 grit sandpaper hot glued to a pine block.

Start of by cutting out three blade blanks to a measurement of $1 \frac{13}{16}$ " x 12".



Carefully remove the paper from both sides of all three blades, If you have issues removing all the paper you can run water over the foam and the paper will rub off with your fingers.

With your sanding block sand all four sides until uniform.

From your bag of bamboo skewers select three straight pieces and cut to a length of $10 \frac{1}{2}$ " Tak glue these in place to the leading edge as shown making sure the everything lays perfectly flat against the table. Do not use excess glue here as this will make sanding much harder in later steps. Repeat the process for the other two blades.

From your $\frac{1}{8}$ " piano wire cut three pieces measuring $1 \frac{1}{2}$ " and tak glue these to leading edge tip as shown.





Sand the leading edge as pictured. Flip the blade around and place a mark $\frac{3}{4}$ " from the trailing edge on both sides and connect the marks with a straight edge. With your razor blade held at a 45 degree angle carefully cut away some of the excess foam careful not to cut past the line you drew. With your sanding block sand the trailing edge as pictured until the line you drew is sanded away. Absolute perfection is not critical here we just want to establish an airfoil shape. Repeat the process with the other two blades.

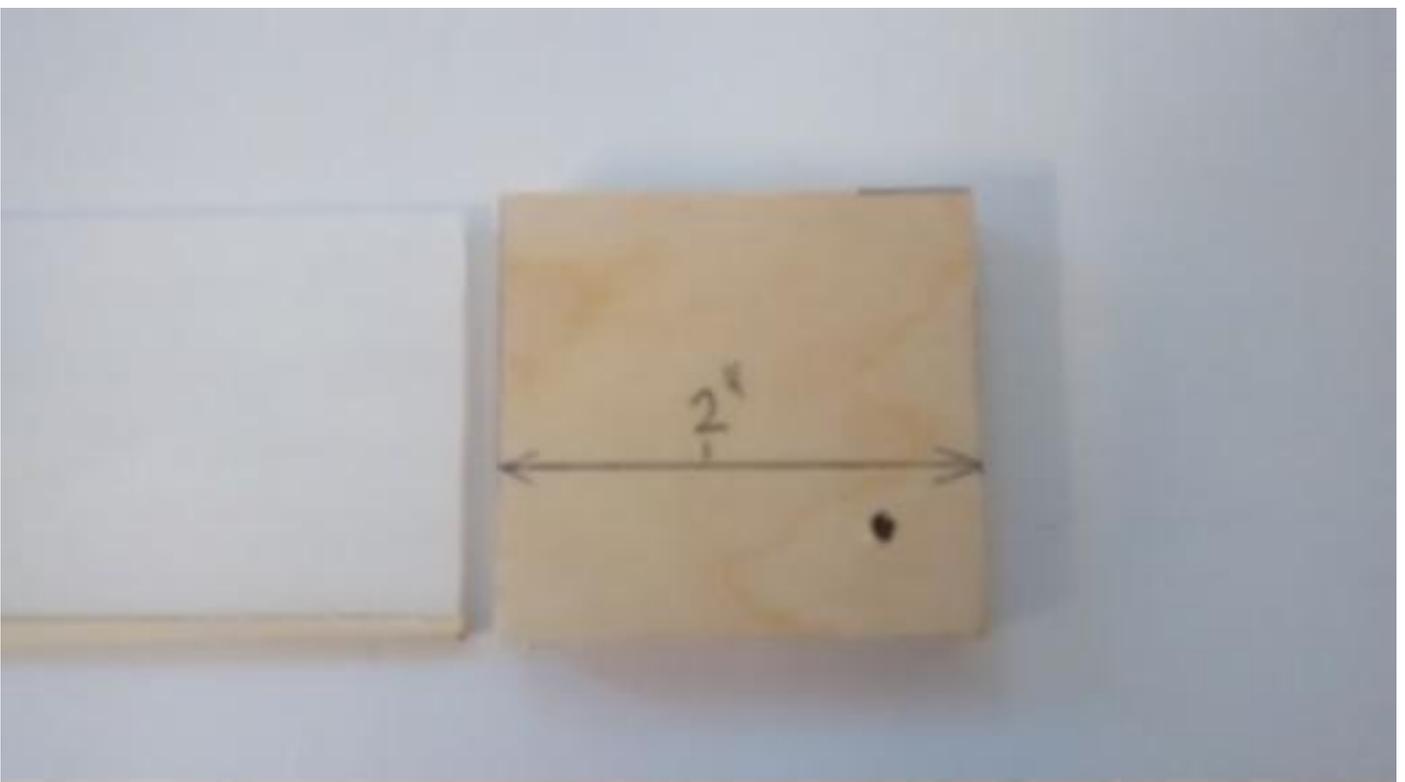


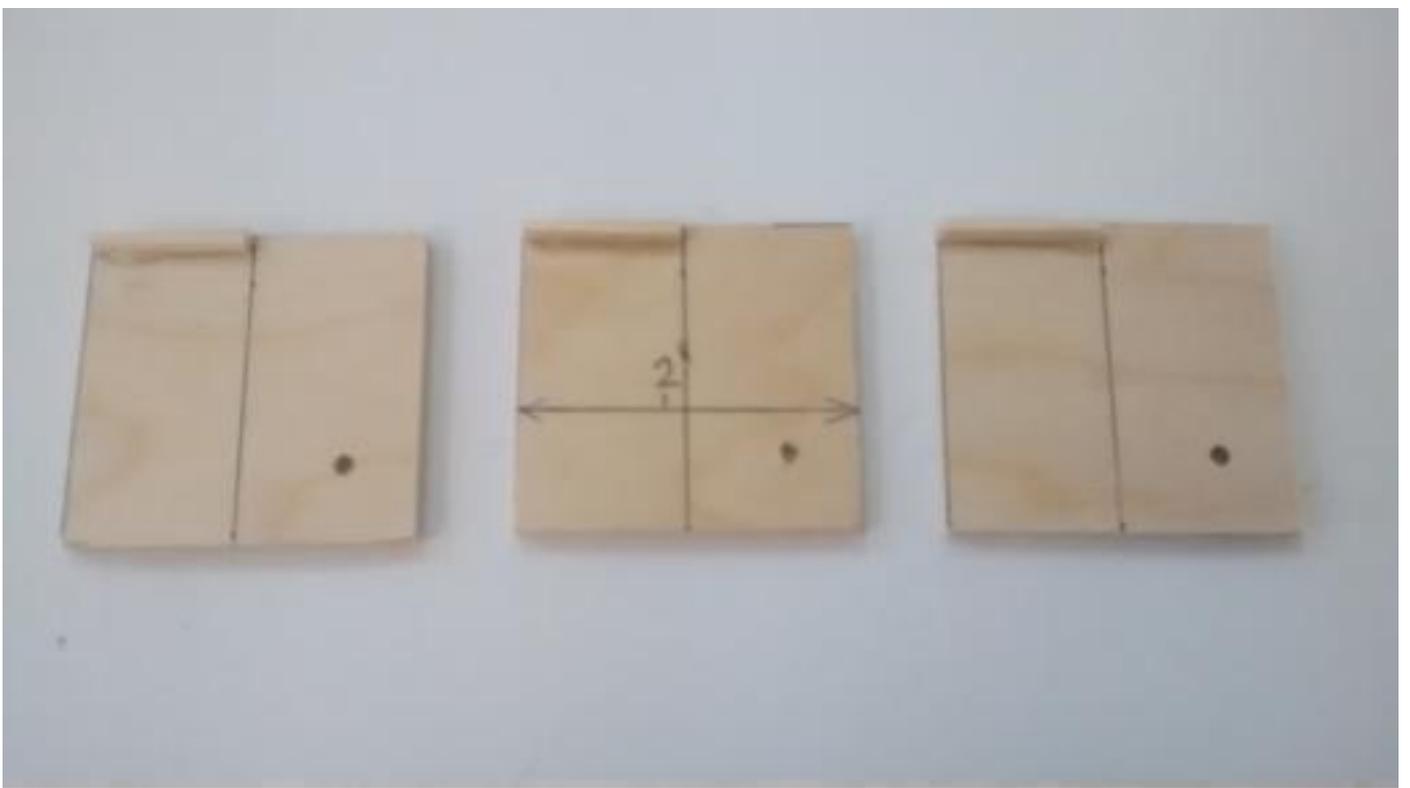


Now we can make the blade holders which will allow our rotor blades to be bolted to the autogyro at the correct angle of attack. From your 1/8" plywood cut three pieces measuring 2" x 1 15/16"

Clamp your three pieces of plywood together and sand all four sides until they are equal. Measure 7/16" from one edge and 7/16" from the bottom and drill a 1/8" hole through all three pieces.

Draw a reference mark 1" from the edge as shown. Glue on a 1" section of bamboo skewer as pictured, this will allow our rotor blades leading edge to angle down for flight. If you get it wrong and the blade are angled up **YOUR MODEL WILL NOT FLY.**





Now we can glue the blades to the holders. Place a scrap piece of 1/8" plywood on the left side so our blades will be level when we glue them down. lay a light bead of glue at the bottom and on top of the skewer we glued down and lay the blade in place using the reference line we drew as a guide. Go back and reinforce the joint with more glue. Go easy with the glue in this step if you try to put too much glue down you could distort the foam, changing the angle we established.





Now we can cover our blades in packing tape, this will not only make them more durable but also increase their performance. Start out by cutting a piece of 2" packing tape to the length of the blade and laying it across the top trailing edge as shown, cut a slit in the tape at the edge of the plywood where the blade holder is so the tape doesn't distort. Fold the tape over the trailing edge to the bottom and with your finger carefully work out any wrinkles. Flip the blade back over and cut another section of tape to the same length and lay it over the first piece slightly overlapping it. cut another slit in the tape where it meets the plywood and fold the tape over the leading edge onto the bottom and work the wrinkles out. If your blades develop wrinkles later on careful use of a heat gun will remove them. Repeat this process for the other two blades.





Color the tips of two of your blades with sharpies, this will be for tracking later on if we need to make adjustments. Using the shortest of the m3 bolts bolt the blades on with two m3 washers and a m3 locknut.

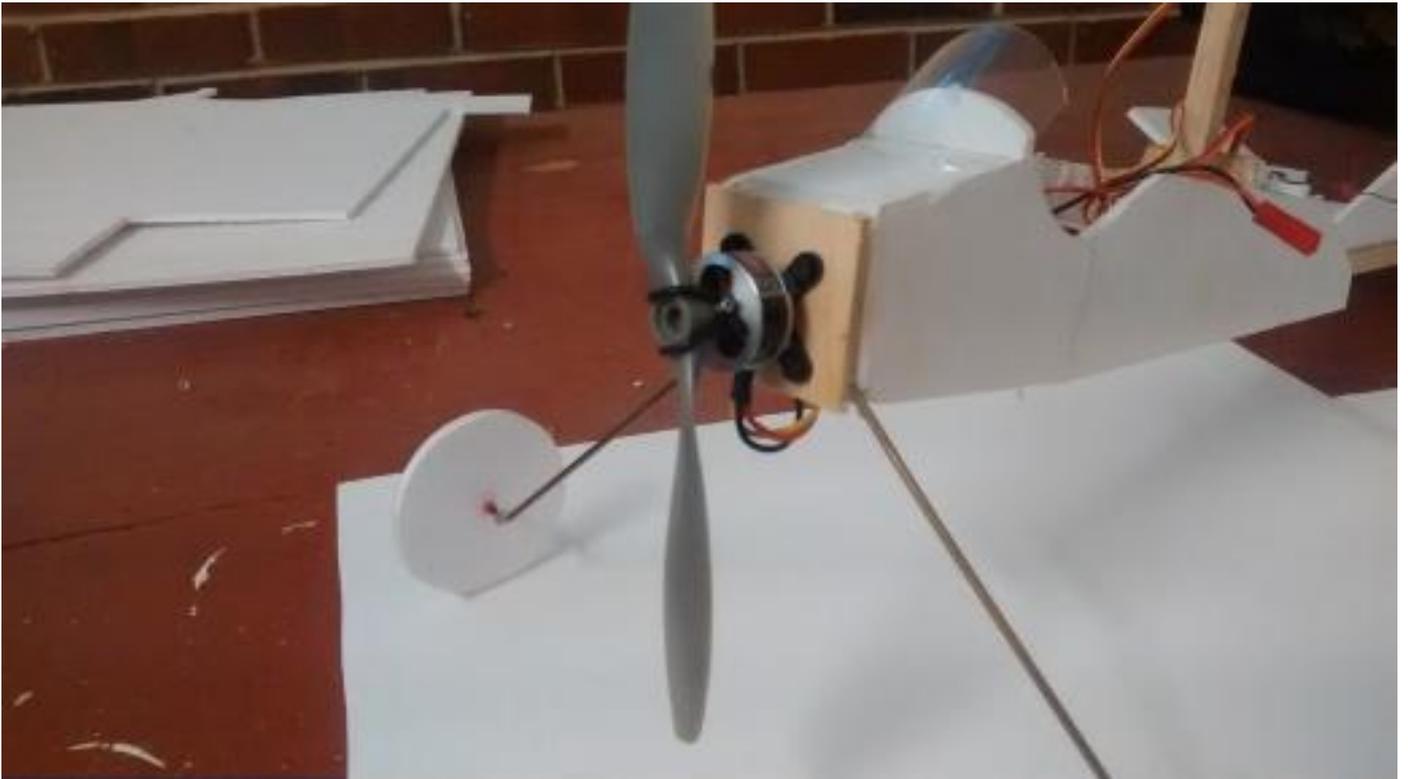


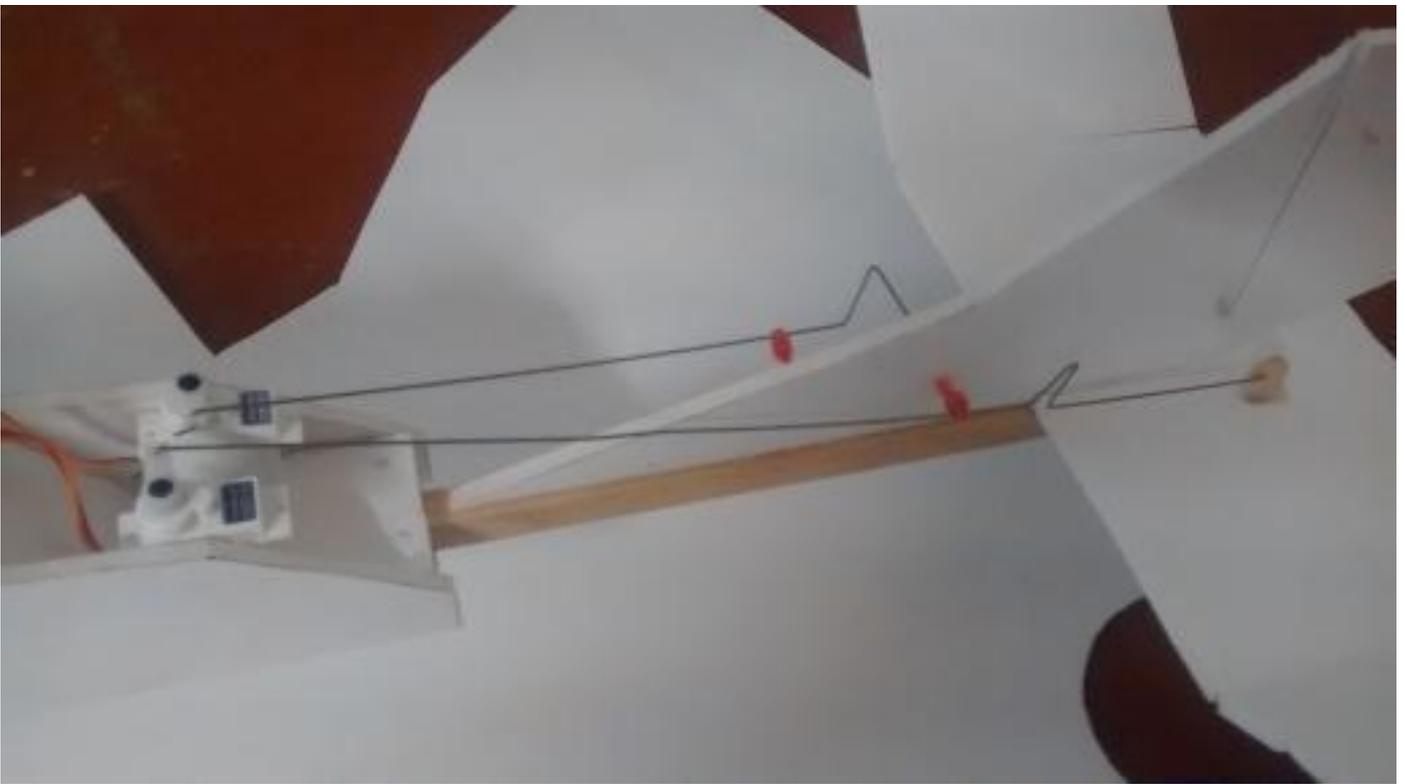
If you made it this far congratulations! Now we can see if your hard work paid off and the model will auto rotate. Take the model outside and tip the rotor back at 45 degrees and give the blades a counter clockwise spin with your finger, a fast walk forward in calm conditions should allow the blades to slowly come up to speed and a slow jog will make the blades "sing" You should be able to feel the model trying to pull out of your hand.

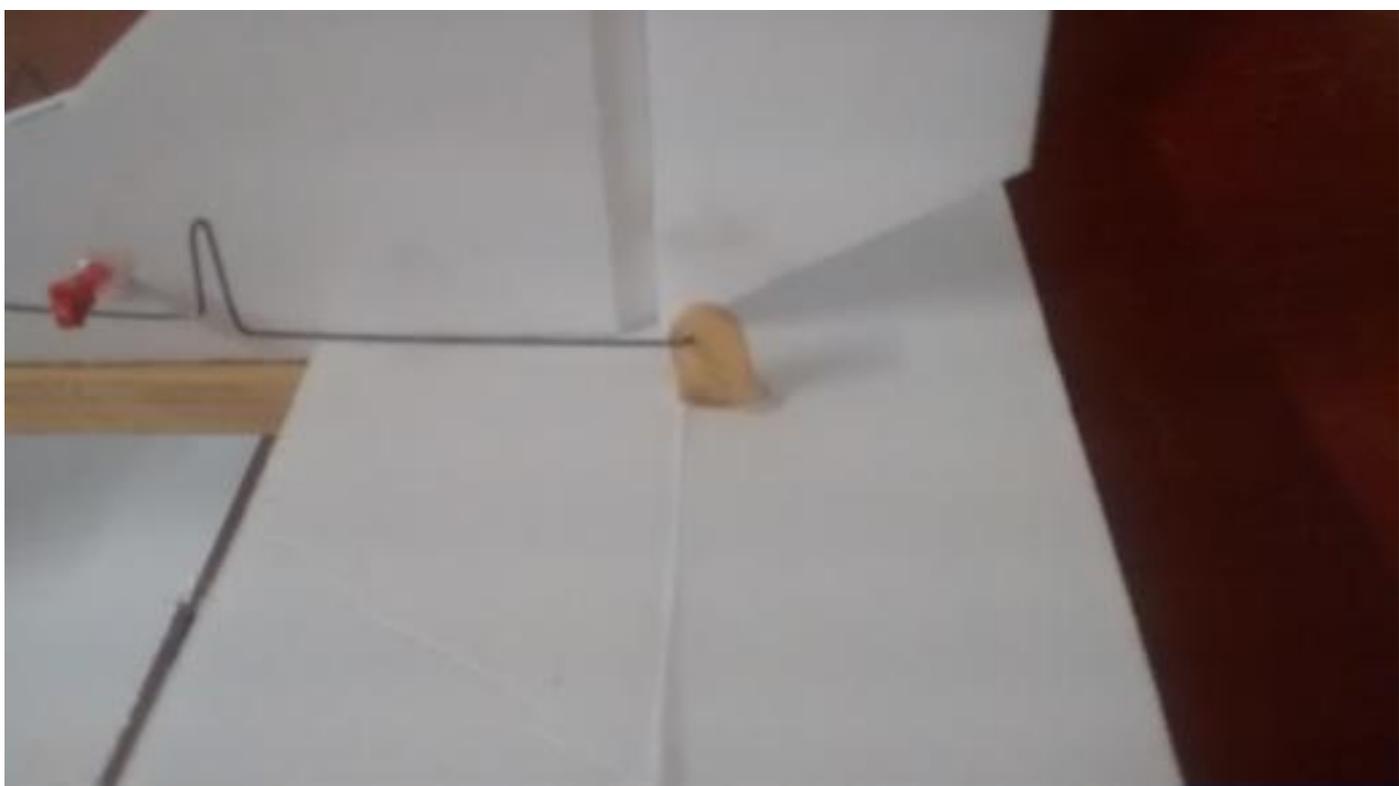
Installing the Electronics and setup procedures

Solder your speed controller to your motor for clockwise rotation "prop should turn clockwise when looking from the rear" If your motor has a rear protruding shaft go ahead and drill a hole in the firewall for that. Install your motor using four servo mounting screws. It is recommended that you use a prop saver in case of a crash.

Install the tilt servo to the mast by gluing two small blocks of wood in place and using the mounting screws that came with your servo to hold it in place. The elevator and rudder servos can be glued to the inside sides of the fuselage just behind the mast. The rudder and elevator control horns can be made from a small section of Popsicle stick. You can also use a plastic shopping card. A hole the size of the piano wire you use should be drilled into the horn and that hole should be half an inch above the control surface and the hole should be in line with the control surface hinge. It is recommended that you put v-bends in all your control rods so you can make mechanical adjustments later on. You can support the control rods with small zip ties glued in place. Make and install your tilt control rod so that the model has a small amount of left tilt built in with your servo centered, around 3 degrees of left tilt "when viewing the model from behind" will be a good starting point.







If you are a beginner to autogyros it is recommended that you install a flight stabilization unit until you learn how to fly your autogyro then later you can experiment with turning the stabilizer off as you get used to the models flying characteristics. IF you fly with a spektrum radio the Lemon RX stabilizer plus gives you a receiver with autoleveling all in one unit. To set it up plug your servos into the receiver and turn dip switches 1, 3, 4, and 5 to the on or forward position. Turn elevator and rudder gain all the way up and aileron gain to about 80% to start. Bind the receiver to your radio like you normally would. The gear switch on your radio toggles the different flight modes. If you use a two position switch, switch position 0 will be stabilization off and 1 will be autolevel. If you have a three position switch, position 0 will be stabilization off, position 1 will be normal gyro compensation, and position 3 will be auto level.

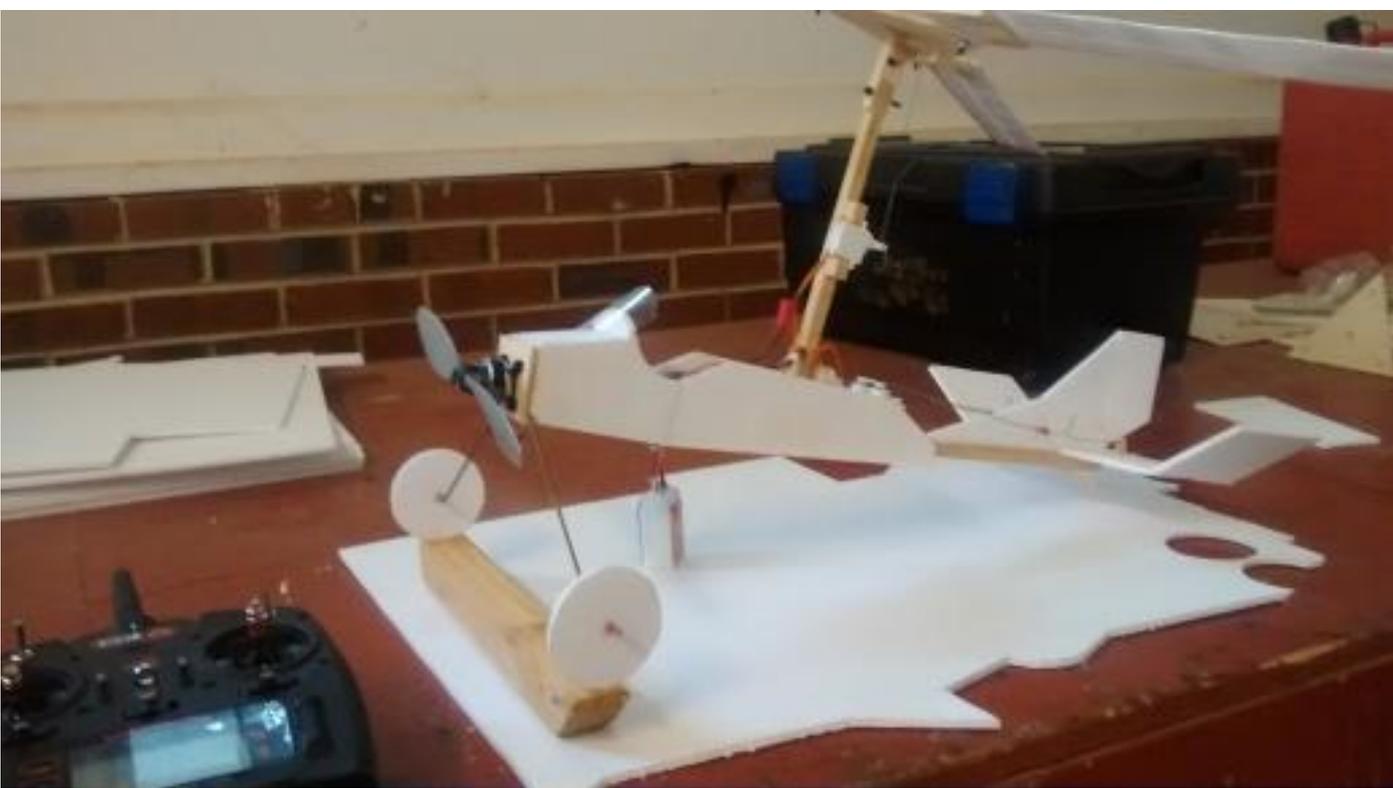
Just to confirm, the lights on the receiver will be as follows, solid green/red light stabilization off. Solid green light, normal gyro stabilization. Flashing green/red light autolevel.

To establish the proper level flying attitude prop the models front wheels slightly off the ground as pictured. Turn your radio on and then plug your battery in. Before the gyro initializes indicating what flight mode your in switch your gear channel back and forth in rapid succession, a solid red light will come on indicating you did it properly.

After flying the model and making any trim changes you will need to do a "level trim" reset so the model will not interpret trim changes as control inputs when flying in autolevel mode. To do this turn your radio on and plug your flight battery in then wait until the gyro initializes and then flip the gear channel back and forth in rapid succession just like before, you should get a very faint change from the green light indicating you did it correctly.

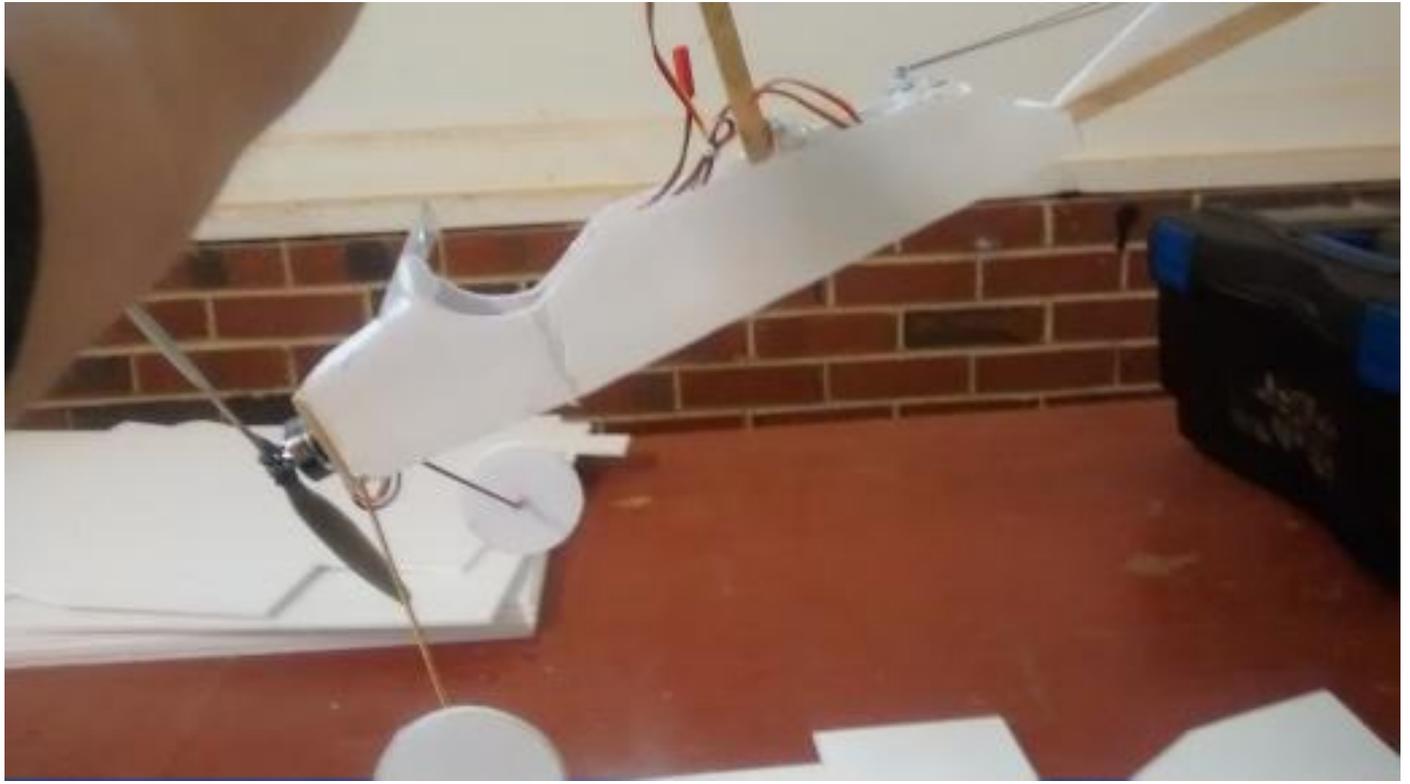
To confirm flight stabilization works properly turn your radio on and plug your flight battery in. Put the model in autolevel mode and confirm that when the model is tilted to the left "when looking from the rear" the rotor head tilts to the right. When you tilt the model forward the elevator should go up. When the tail is quickly swung to the left the rudder should move left.

If you fly with a computer radio add in a 50% rudder to aileron mix, this will make the model coordinate turns automatically.



Balancing your model

An out of balance autogyro flies much like a tail heavy airplane except your much more likely to crash. A three cell 800 mah lipo battery pushed all the way forward will get you very close to the optimum 20 degree hang angle we want. With your battery in place pick the model up by the mast and measure the angle at the bottom of the fuselage. If its less than 20 degrees nose down you will need to add weight to the nose. Adding a higher capacity battery is the easiest way to add weight to the nose. Bigger heavier wheels will also get the center of gravity more forward. In extreme cases you may have to move the mast rearward.



Your first flights

Your first flights should be done in calm conditions only. If you built everything correctly a fast walk up to a slow jog is all you need to get the blades to spin up to the correct rpm. Leave those windy day flights for another time when you have got a few hours under your belt. Be sure your flying area is of adequate size, a park or soccer field free from obstacles is perfect.

Although autogyros fly in similar ways to a fixed wing plane they have their own unique flying characteristics. A lot of rudder will be required in turns with careful roll coordination to complete turns.

Before your first test flight tilt the model back 45 degrees and give the blades a counter clockwise spin, walk into the direction of any prevailing wind if any when you feel the model slightly trying to pull out of your hand the model is ready to fly. "DO NOT LET GO OF THE MODEL AT THIS POINT" briefly loosen your grip to see if the model wants to pitch up or go left or right and adjust your trims accordingly. "be sure to do a level trim toggle if you are using the lemon stabilizer plus.

Now you are ready for a hand launch "do not attempt to take off from the ground unless your a seasoned autogyro pilot. A roll over is likely to result. Turn autolevel on for the first flight. Tilt the model back 45 degrees and give the rotor a spin, walk forward faster and faster until the model is slightly pulling from your hand and release the model in a level flying attitude. There is likely to be a sharp left turn if you release before the blades are up to speed and possibly a crash. Establish a good height but not so far away you loose orientation. Use the throttle to control your altitude and careful use of rudder and aileron coordination to turn. When you are ready to land use the throttle to control your descent rate and steer with the rudder until you touch down.

Congratulations you are now a autogyro pilot and will be hooked for life. :)