Pack 442 Space Derby

1. Overview

Space derby is a racing event for Cub Scouts in the Boy Scouts of America that is like the pinewood derby car race. Cub Scouts race miniature Balsa wood rockets that are propelled by a rubber band and propeller.

2. Check-in

Registration begins at 8:30 AM and **closes** promptly at **9:30 AM** for design judging and the start of races.

There will be **open-track time** Friday night from **7:00pm to 8:00pm** for anyone who would like to **test out their rocket.**

3. Volunteers needed

As with everything in scouts, volunteers are the lifeblood of space derby. Below are the minimum required volunteers:

(a) **Organizer**

(b) **Setup/take down**: three people each for 1 ½ hours each.

(c) **Inspection and registration:** two people (one hour each on race day)

(d) **Design competition**: two people (1-2 hours preparation and 1 hour at the start of the race)

(e) **Bake sale**: Tiger den

(f) **Start and line officials**: four (we had boy scouts and it worked out great – about 3 hours each)

(g) **Finish line officials**: two (one to run the camera and one to hand back racers)

(h) **Pit crew**: shift of two throughout the races. These are people who help repair when damaged.

(i) **Winding crew**: seven – **bring cordless drills**!

4. Pre-flight inspection

(a) Rockets must be submitted for inspection on race day at the registration table.

(b) Each rocket will be inspected, registered, and assigned a sticker with a number and color.

(c) After registration, rockets will be placed on the design judging table of the scout's choice.

5. Rules of the race

To pass inspection and qualify for the race, rockets must comply with the following rules:

(d) Only parts contained in the official BSA Space Derby kit may be used.

(e) You may add decorations to the kit parts if the rocket otherwise complies with these rules, is flight-worthy, structurally sound, and doesn't interfere with another rocket during the race. There are no weight restrictions.

(f) You do not need to be present to race. You may have someone race for you, but your rocket does need to be checked in by 9:30 AM on Saturday. Let the registrar know who's racing in your place.

(g) Rockets must use the hanging device supplied in the kit.

(h) Do not glue the nose cone/propeller assembly in place.

(i) Create a notch or groove in the tail of the rocket to seat the band-holding dowel so it doesn't spin as the rocket is wound. But do not glue the band-holding dowel in place.

(j) The rocket body may not exceed seven inches in length, excluding the propeller and fins.

(k) Rockets may not use more than three rubber bands at once.

(l) Rockets with wet paint will be disqualified.

(m) Scout may use graphite powder between the propeller and the bushing if desired. Other forms of lubrication are prohibited.

(n) Once the rocket is submitted for entry, no further adjustments may be made except in the case of mechanical failure.

(o) Only one rocket per scout.

(p) No late registrations will be accepted after the races have started.

(q) If all rockets don't reach the end of the track, the one that goes furthest is the winner.

(r) All rulings by judges are FINAL.

6. Building your rocket

The following tips are meant as a guide only – "Space Derby 101" if you will. They're intended to help prevent common mistakes made during rocket assembly. The construction ideas you come up with, and the tweaks you decide to make, help determine whether your rocket ends up in the Winner Circle!

A. Parts

Your Space Derby kit should contain all the materials depicted in the below photo. If it doesn't, please return your kit to the Pack to be issued a new kit, or the missing components (based on availability).

Kit Contents

Read complete instructions and review the plan to identify the various parts of the kit. Each kit contains the following parts:

- 1 - Propeller
- 1 - Brass Bushing
- 1 - Nose Button
- 1 - Plastic Tube
- 1 - Wire Propeller Hook
- 1 - Hanger Fitting
- 1 - Plastic Dowel
- 1 - Number Sheet
- 2 - Balsa Body Blanks
- 4 - Rubber Bands
- 3 - Plastic Sheets for Wing or Fins
- 1 - Instruction Sheet/Plan

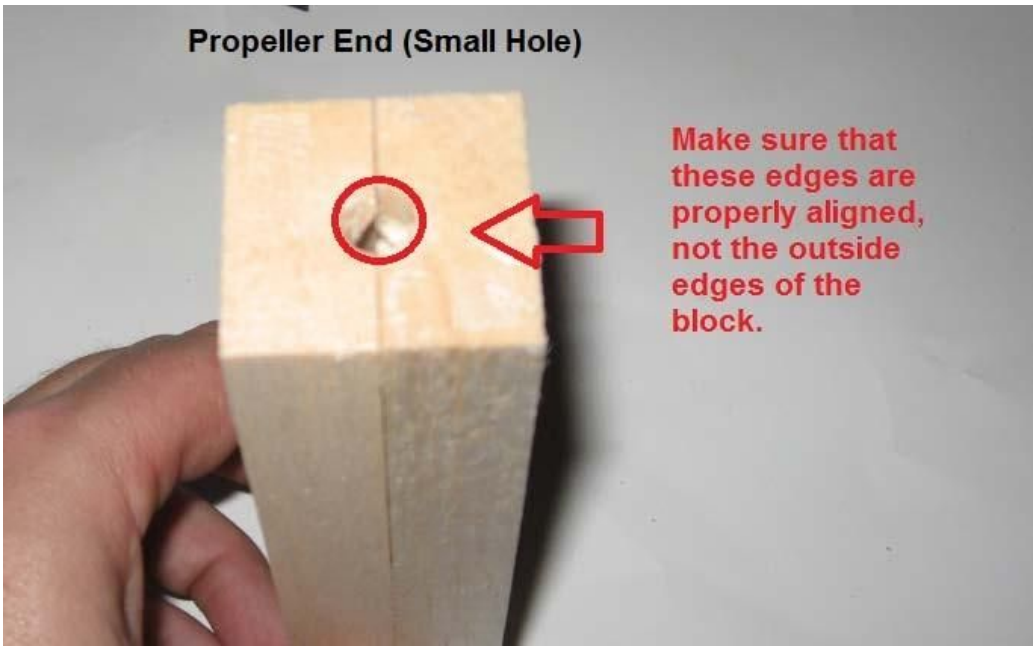
B. Assembling the Balsa body blocks

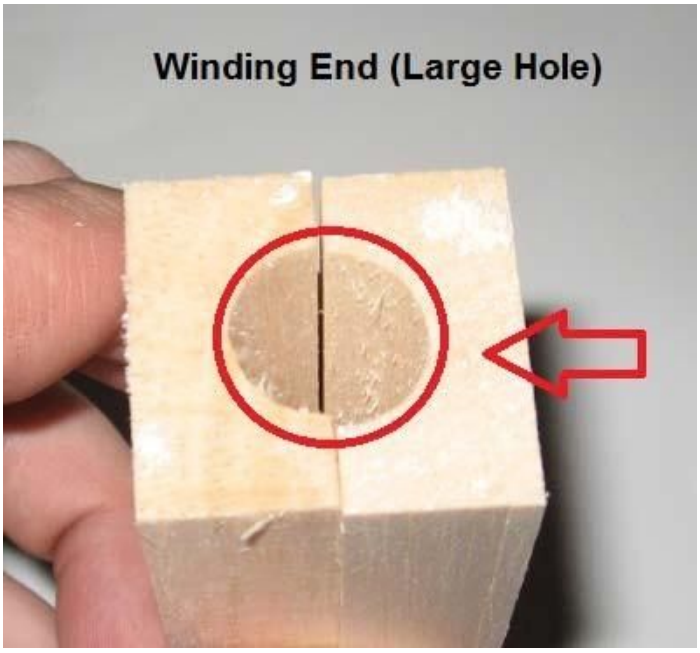
First, let's review the beginning guide step included with your kit:

1. First, cement the two Balsa body blocks together, using only a water-based wood glue. Before the glue dries, align the blocks evenly, then insert the nose button temporarily in place, to be used as a guide when sanding the rocket. After glue is completely dry, shape the rocket body, using only sandpaper (no knife). Grooves for the hanger fitting & fins can be scored onto the Balsa, using a pointed object such as a pencil (see plan for location).

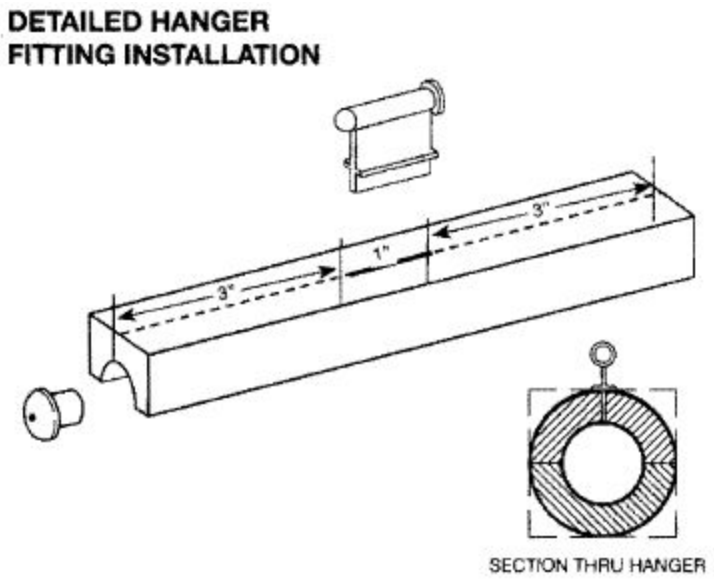
Before you cement the two Balsa halves together, there are a few things you ought to consider. First, are the inside edges of the wood well sanded, and free of splinters that may damage your rubber band motors?

Second, do the two halves align properly? It's possible to have the outside edges of the wood match, but the inner holes not match. Hold your two halves together, and make sure the holes are aligned.

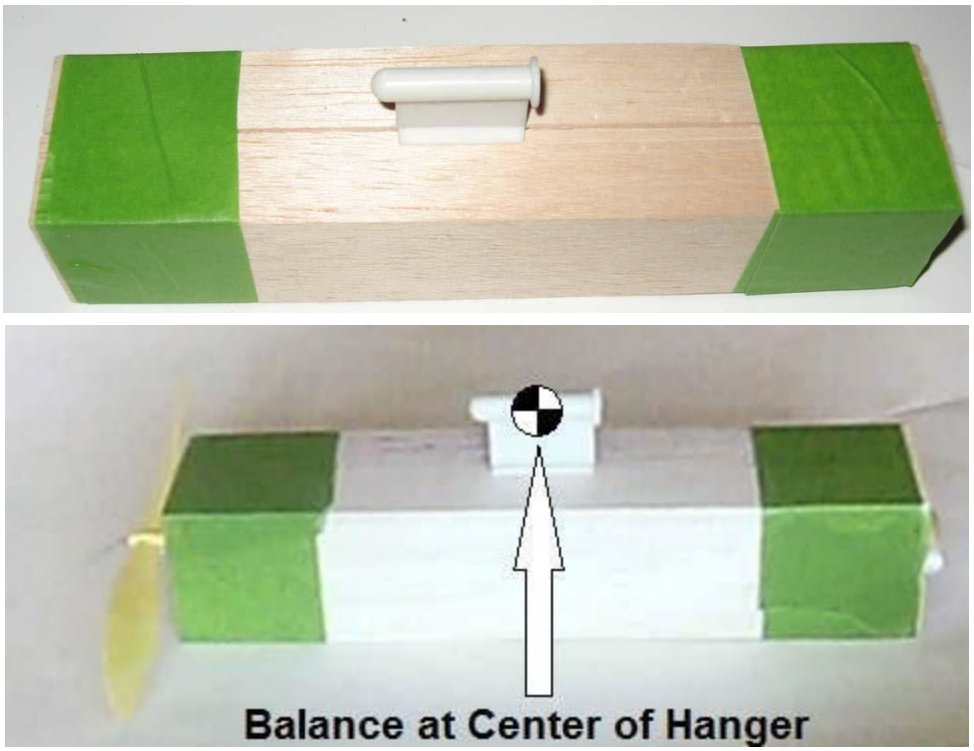




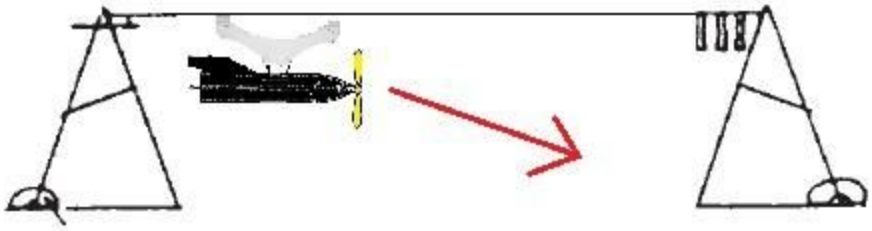
Next, you want to consider placement of the hanger. According to the instructions, the hanger should be placed as shown below:



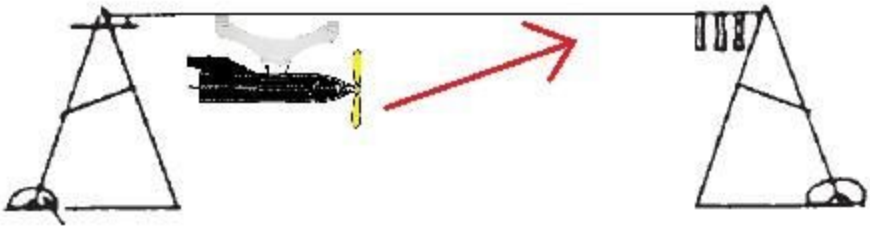
But this “generic” placement doesn't account for the balance of your rocket. To fly straight & fast, you want your rocket to be balanced on the center of this hanger. To get the “best” balance, you can temporally tape the two halves together, and fully assemble your rocket:



You want your finished rocket to balance on the center of the hanger (as shown above).



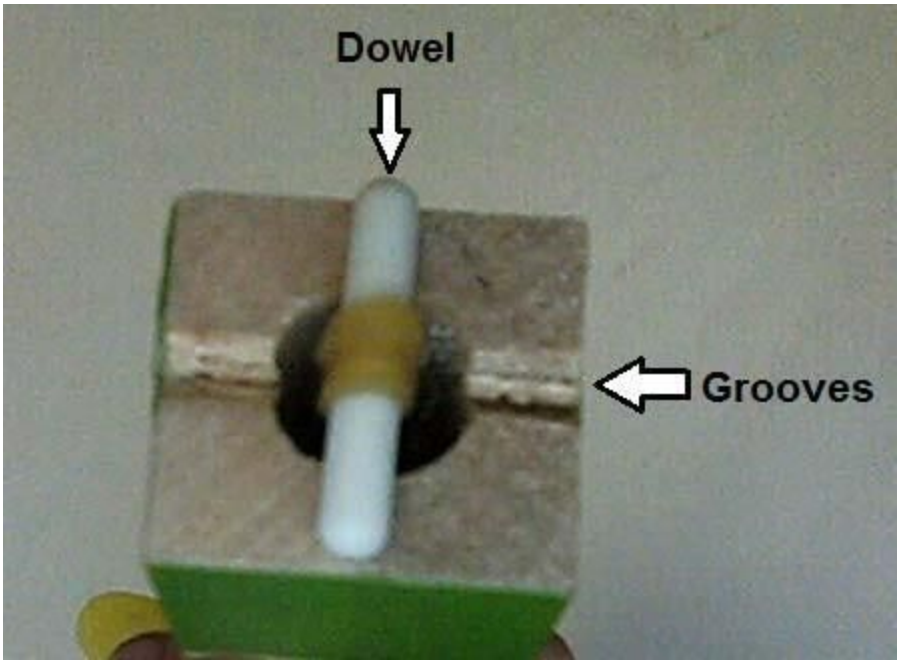
If your rocket is too tail heavy, it will tend to fly up (and swing side-to side).



Once that you decide your rocket's balance is correct, you can glue the halves together with a Water-based glue. By using water-based glue, you can re-adjust your center of balance (after you sand your rocket body) by soaking the rocket in water (to dissolve the glue), and re-tape the rocket together as shown previously.

Be careful not to get glue on the plastic carrier, especially in the holes through which the monofilament line runs. Glue can interfere with smooth operation.

The last thing you want to do before gluing your halves together is cut a groove for the dowel (rubber-band holder, on the winding end). This keeps the rubber bands from spinning as the rubber bands are wound. The reason you want carve the grooves now is there is more material available, to keep the wood from cracking or splintering. If you cut these grooves after sanding, you could cause damage to your rocket body.



C. Shaping the assembled Balsa body blocks

Lighter rockets go faster! But the more material you remove, the less stable the structure of your rocket will be (when fully wound, the three rubber bands in the rocket create significant compressive force). You must strike the right balance.

Reduce air friction or "drag" by making all surfaces as smooth as possible. A blunt, rounded nose causes less drag than a sharp nose. A good design has all leading edges rounded and trailing edges tapered to reduce the drag.

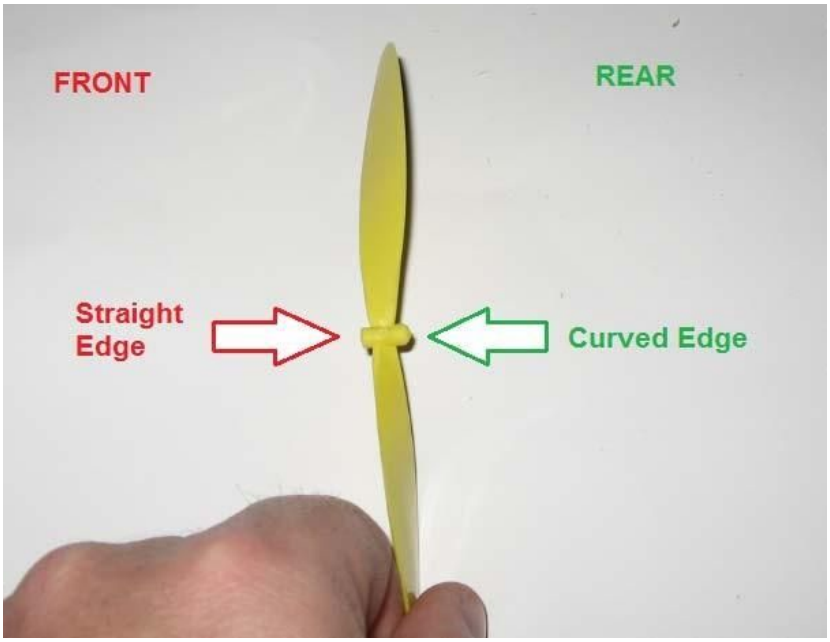
Use a sharp knife for cutting the grooves for the hanger fitting and fins. A dull knife will crush and splinter the Balsa wood.

A new potato peeler is good for carving the shape. When you start to carve, remember that the end with the small hole is the rocket nose.

To help increase the rocket's speed reduce the wall thickness to a minimum of 1/8 inch. Be careful not to weaken the area around the hanger (carrier) or carve away the nose-button circle.

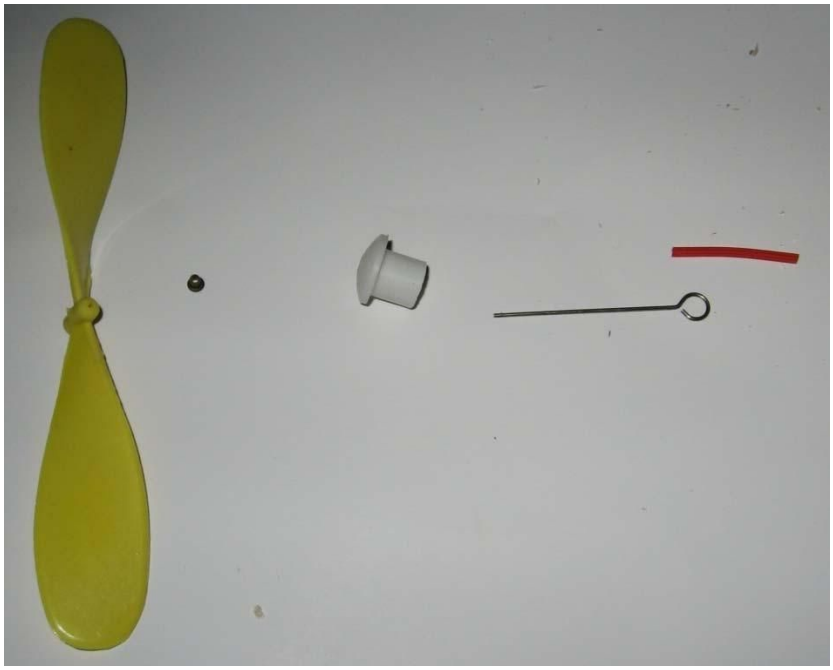
D. Propeller assembly

Once your body is finished, you're ready to begin the propeller assembly. First, you need to identify the front and rear of your propeller.



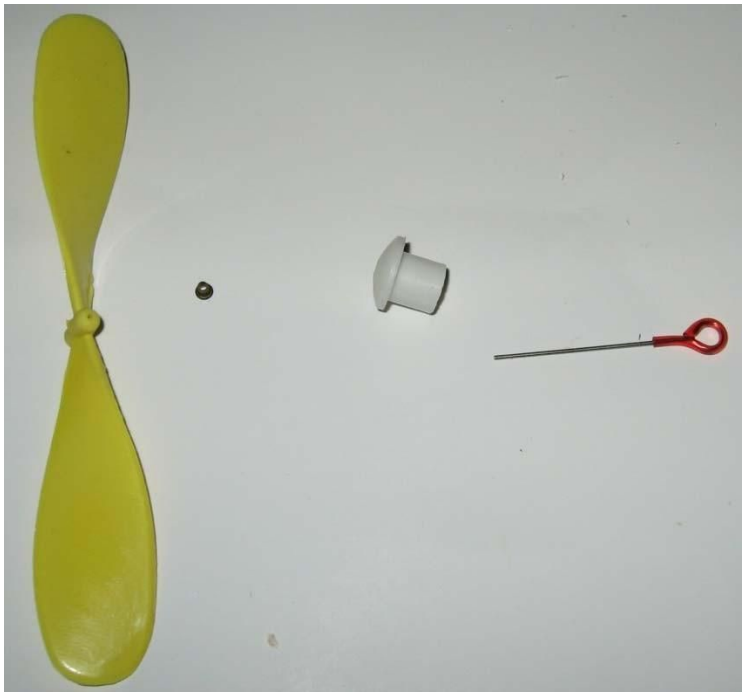
The propeller should have the rounded shaft-end pointing into (touching) the space derby (this makes the bending of the wire easier and it reduces friction). If you mix-up this assembly point, and install the straight edge facing the rocket body, your rocket will fly backwards!

Next, lay-out the parts for the propeller assembly in the order that they are to be installed:

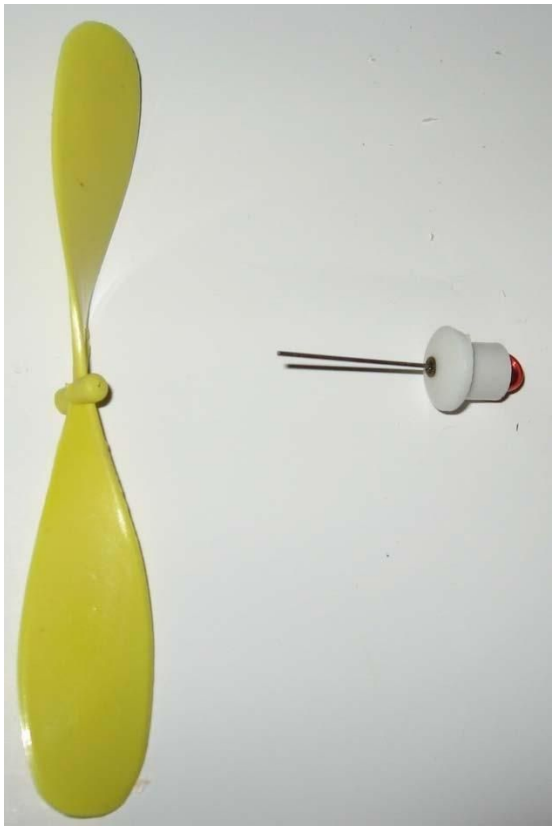


The little red, plastic straw *must* go over the hook (not just the shaft as the drawing in the space derby kit illustrates). This is where the rubber bands will attach, and without the red, plastic straw to protect them the shaft will cut the rubber bands!

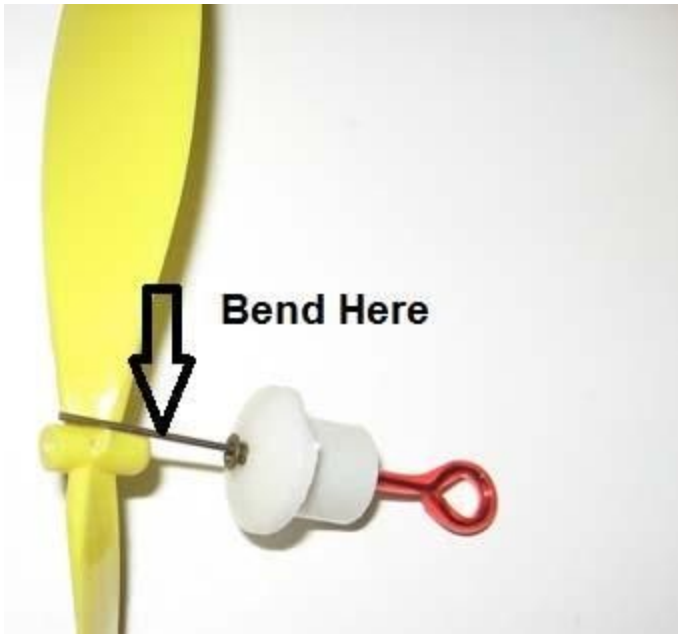
Install the plastic tube onto the shaft, as shown below:



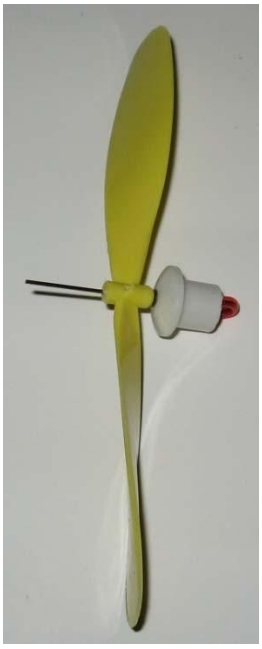
Insert the shaft through the nose piece, & bushing.



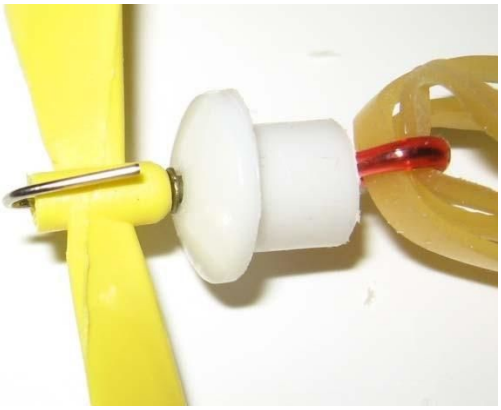
Check the overall shaft length against the derby kit instructions. Shaft length should be no greater than 1 ¼" inches in length. By laying the propeller next to the shaft, you can mark the point where the wire needs to be bent.

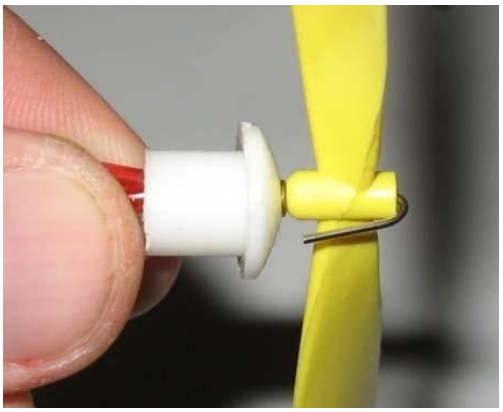


Install the Propeller onto the shaft.

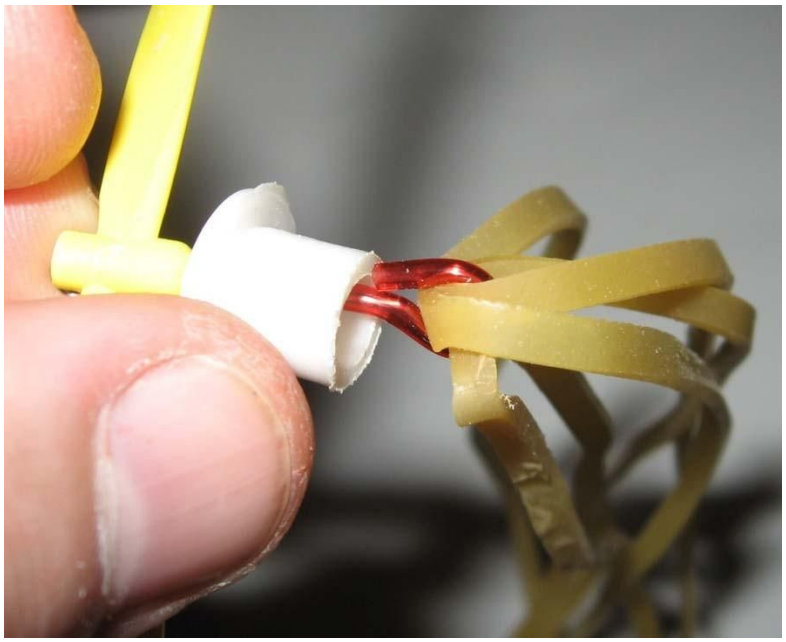


Make the bend in the wire. Make the propeller shaft as short as possible by bending it close to the prop. Cut off the excess wire with wire cutters. The finished bend should look like the pictures:

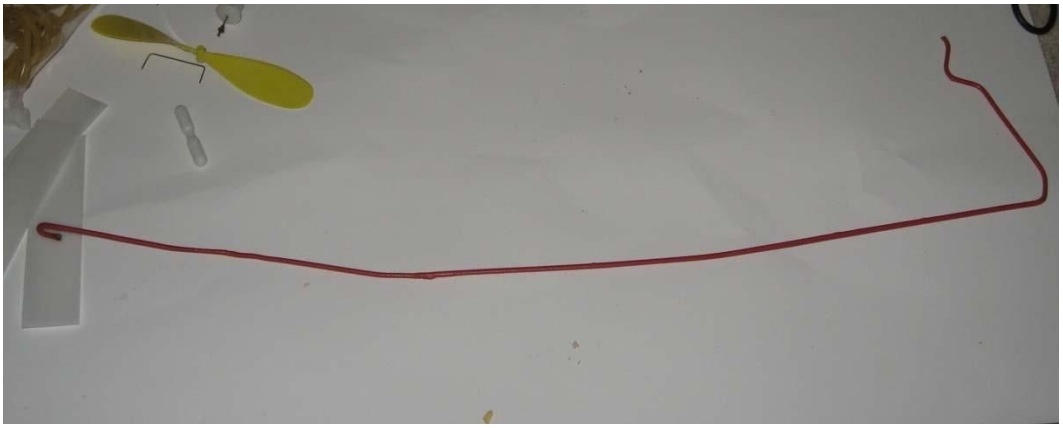




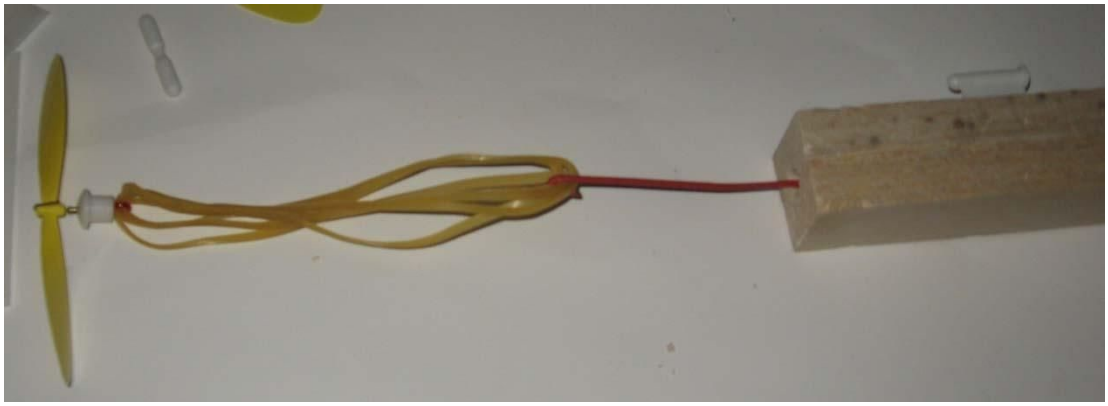
Install three rubber Band motors onto the shaft.



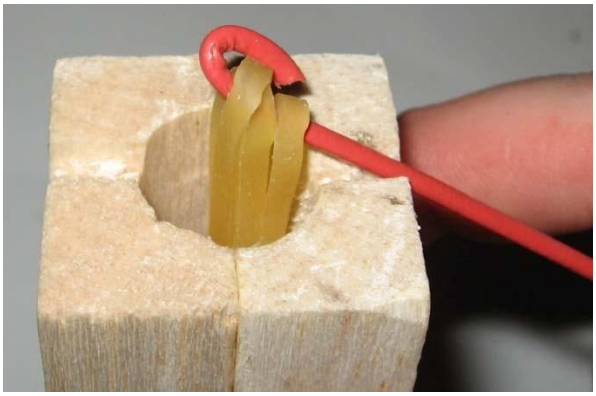
You are now ready to install the propeller assembly onto the rocket body. You'll need to make the "Hook" tool described in the "Helpful Suggestions" section of the derby instructions:



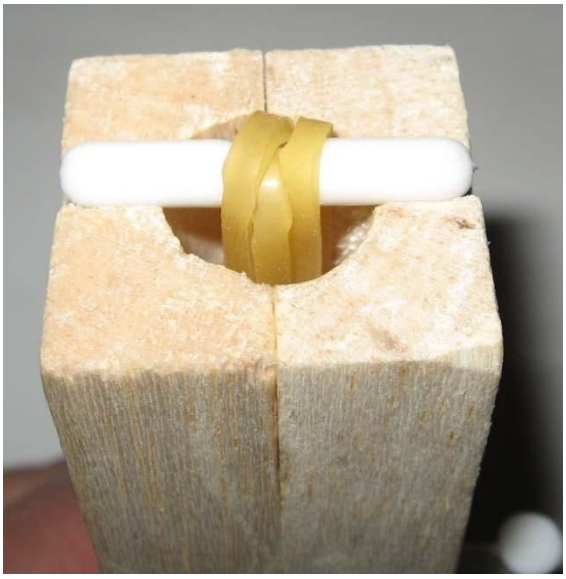
Insert the hook tool through the rocket body, and hook onto the rubber band motors.



Pull the rubber bands through the body, and hold them in-place as shown:



Insert the white dowel through the rubber bands, and remove the hook puller:



Do *not* glue the propeller assembly into the front of the space derby. It is pulled off to re-load new rubber bands!

Do *not* glue the back dowel onto the rocket. It is pulled off to re-load new rubber bands and wind the rocket!

You may lubricate the propeller nose button with graphite.

Now you should be ready to run your first motor tests.

E. Rubber bands

Use only the rubber bands provided with the kit. For more speed, attach three rubber bands, not one. Using more than three rubber bands is not allowed.

Lubricate the rubber bands before the derby. This prolongs the bands' life and power and helps reduce the possibility of breaking during the competition. They can be soaked overnight in castor oil. Or mix two-parts green soap, one-part glycerin, and one-part water and rub the mixture on the rubber band about an hour before racing.

Have extra boxes of rubber bands on hand. Remember, it takes three rubber bands to fly each ship properly.

7. Running the race

A. The gear

All space derby gear is in the Pearwood storage unit. It includes the following: the two wooden structure that are the beginning and end of the track; winders (made of all-thread); hangers; guide ropes, and everything else you see in the setup video.

B. Advanced purchases

NOTE: Check the Pearwood storage unit before making any purchases. We have lots of cups and other gear there.

Each year, go to the scout shop and buy two boxes of Space Derby **rubber bands**. Lubricate them the night before race. Also, buy **extra hangers**. This will likely need to be done before each year's race because, over the large number of runs, the plastic on the hangers will break – even the new ones. Make sure to purchase **super glue** to resolve this problem on the fly.

Have a **spare-parts kit** for the pit area.

Order **awards** to hand out on the day of the race. From where is up to you. Remember that we are tax exempt. We award trophies for 1st through 6th place and ribbons for the design categories (which can be anything, but usually include things like Scout Theme; Most Patriotic; Space Theme; Most Creative; Funniest).

Only the six fastest overall rockets get trophies, regardless of scout rank. We do not race based on scout rank.

Purchase **small colored sticky dots** (about ½ in diameter), at least two colors and enough for all the participants. Since this is not a timed event, we use this method to determine who is in which heat – more below.

Arrange for use of an **HD video camera** and **tripod**.

Plastic cups

C. Bake sale by Tiger dens

Tiger dens are responsible for a bake sale during the race. Tiger families provide baked goods like cookies, brownies, cupcakes, or similar small baked treats, which should be dropped off in the kitchen area. The baked goods are sold for donations to the pack. One or two folks need to man the booth during the race.

D. Setup

First, here's a video of the fully setup space derby track in 2016.

If possible, reserve the facility for the night before the race. If not, allow at least 1-1/2 hours to set up before the race on race day.

Get the track from the storage center. You will need a pickup truck because the track is too unwieldy for a mini-van or a truck with a cab cover. It is light enough for two people to pick up easily.

Set up the two pieces roughly 60 feet apart. Only 50 feet is needed for racing, but you need to stop the flyers gently. The track has seven lanes. Although you can use a single line threaded through each of the eye-hooks, a better practice is for each lane to have its own line, and for each line to be weighted with identical weight (e.g., a milk jug with a pre-measured volume of water in it).

When setting up, to keep the track from shifting, a large amount of weight needs to be put on both sides of the supports. In the video, you'll see how we use water coolers filled with water for the weight.

We set up a **HD video camera** at the finish line. Line it up with a marking on the floor – either tape or a gym line. With minimal practice, one person can hit record when the starter calls out start and then hit stop when they flyers pass. Considering the speed, this is the best way of judging. An alternative is to have at least 3 parents at the finish line watching two lanes each and then picking out the fastest flyers – strongly suggested you use the camera set up.

E. Running the race

When the scouts come in they will need to check-in their rocket. This is where we will assign numbers to each flyer and keep a log.

And this is where the sticky dots come in. Starting with the first rocket, attach stickers as shown below:

Order registered	Dot affixed
1	Green A - 1
2	Red A - 2
3	Green B - 3
4	Red B – 4
5	Green A - 5
6	Red A - 6
7	Green B - 7
8	Red B – 8
Etc…	

Keep track of which scout is which number. The way we did it was a spreadsheet with the pack roster sorted by name. At the end, you will have the scouts divided into four groups: Red A, Red B, Green A, and Green B.

F. Design voting

After each flyer is registered, scouts place their rocket on the table corresponding to the design category in which they want to compete. **Plastic cups** are placed next to each rocket.

Design voting is done before the race, and only scouts may vote. Parade the scouts down one side of the tables so they can see the different entries and get a feel for which ones they want to vote for. After the go down one side of the tables, circle them back around the other to cast their vote. As each scout approaches a new design category, the design coordinator for that category will hand each scout a colored ticket. Scouts vote by depositing their ticket in the cup next to the rocket of their choice.

G. Racing

We promise each scout they'll get to race their rocket at the least two times.

For the first race, call **all Greens** to get their flyers and line up for racing. Order doesn't matter, just that they are Green (with either A or B).

From each heat of seven, keep the two fastest, and have the scouts put the other five back on the table.

For the two fastest from each heat – keep them away from the scouts to remove confusion.

After all Greens have run once, you will have isolated all the racers that won 1st or 2nd in their heats. Call just those scouts back up and have them get in line to go again. Repeat the process until you are in the final heat for the Greens. At this point, have them race and isolate the three fastest finishers. Keep these three isolated at the front until the final rounds with the other groups fastest three.

This has taken a reasonable amount of time. To break up the monotony, use this point to **award the design categories**.

Next, call up the **Reds** and repeat the process, until you are down to the 3 fastest. After this, every scout will have raced once – some have raced more times.

Now call up all the **A's**. Race down to the three fastest. Now ½ of all the scouts have raced two times. You now call up the B's and race to the three fastest. Every scout has raced at least two times.

Isolated in an 'adult' area, you should have 12 rockets. Break these into two heats of six to race off. How doesn't really matter – but if it is random someone might complain, so we suggest picking either an A heat vs B heat or Green heat vs Red heat.

From each of these two heats pick the three fastest and move those to the final race.

Because of the numbers, the slowest of the final race doesn't get a trophy. If you want to switch and purchase four or six trophies, you can make the numbers work out.

Award the trophies; take down the track and put in the storage area; go home.