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Rocket Design

Materials:

- Fishing line
- Poster board
- Balsa wood
- Glue (super or regular your choice)
- Industrial strength garbage can liner
- Protractor
- Tape (masking)
- Drinking straw

Procedure:

First off, based on the rocket propellant that is made determine what inner diameter is needed for a rocket body (approximately one inch). Take a piece of poster board (11"x 6") and roll the paper the long way so that the propellant fits snugly in the end of the body. Pull up the exposed flap of paper and run a bead of glue down the body and seal shut. Apply tape to flap to hold down paper while drying. Make sure that propellant can still fit snugly in both ends of the rocket before glue is dry.

Next make fins for the rocket. Take a piece of poster board and cut out three right angle triangles with one leg measuring 3.5" and the other measuring 5". On the five inch side make 9 perpendicular cuts in the paper .5" apart and .5" deep, alternate folding the paper bending one piece to the left then to the right so on up the paper. Do this to all three fins. Next draw a circle on a piece of paper the same size as the outer diameter of the rocket body. Take a protractor and cut the circle in three equal pieces (120°) with a

pencil. Then put the rocket body on the center of the circle and mark each 120° mark on the rocket body. Extend the mark five inches up the body making sure it is straight.

Take the three fins and apply glue to each tab and put them on the rocket so they are in line with the marks made on the body and so the bottom of the fins are flush with the bottom of the body. Tape as needed to hold fins in place while drying.

Next a nose cone will be made by drawing a 9" diameter circle on a piece of poster board. Find the center of the circle and mark it clearly. Then make a straight cut from the outside to the center mark. Then roll the circle into a cone shape evenly so that the bottom of the cone will fit over the rocket body by about .5" with a $\frac{1}{4}$ " gap around the outside of the cone to the rocket body. This will provide a pocket for air to get under to lift off the nose cone and deploy the recovery system. Pull up the exposed flap of paper and run a bead of glue down the nose cone and seal shut. Apply tape to flap to hold down paper while drying.

To hold the rocket in place cut out a 1" long piece of balsa wood with an outer diameter that will slide snugly in the rocket body. Next measure the length of the rocket propellant (approximately 2.75"). Apply glue to the outside of the balsa wood (roughen up the surface with sand paper) then from the top of the rocket push the balsa wood down to the point where the propellant will fit flush with the bottom of the rocket. Don't push the balsa wood up from the bottom because the glue may affect the propellant from fitting.

Next create a recovery system. This will be done by cutting out a 15" x 15" square piece out of an industrial strength garbage liner. Then cut out 4 pieces of fishing line 1' long. Tie one end of the fishing line to a corner of the garbage can liner. Reinforce corners with tape to avoid tearing. Repeat with remaining corners. Then put four pin

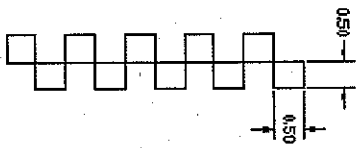
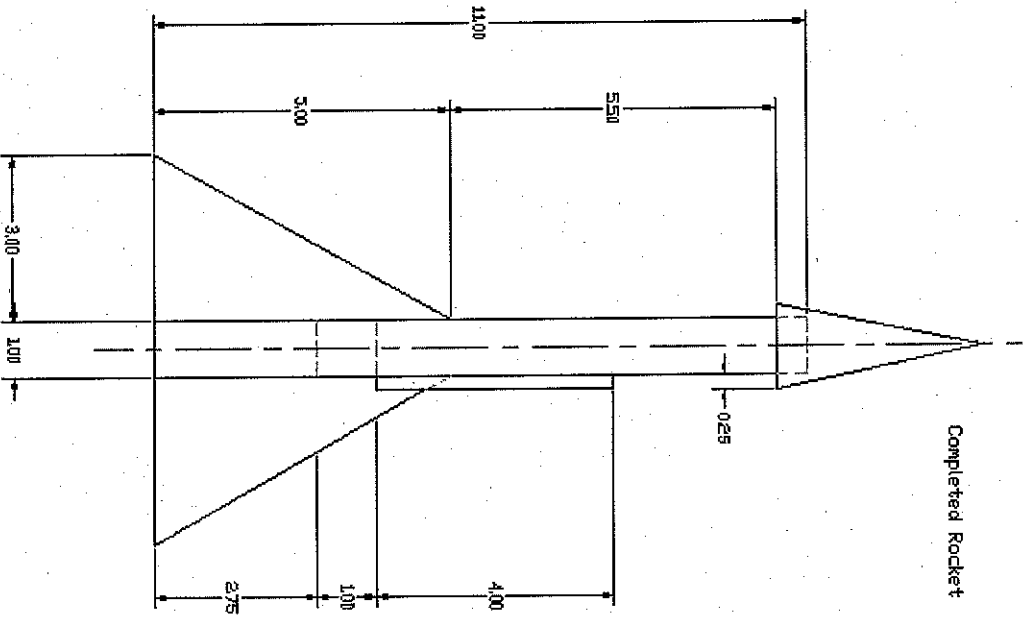
sized holes 90° apart ¼” down from the top of the rocket. Then take the remaining end of the fishing line and tie through the holes in the rocket. Reinforce holes with tape. Make sure to not cross lines and keep the line the same size. Make sure the “parachute” can fit and will be able to deploy from under nose cone. Play with the folding styles to get it right before launch.

Finally a guide will have to be placed on the rocket to make sure it flies off straight and not a people unless that is the desired effect? To do so, cut a piece of a drinking straw 4” long and glue to the side of the rocket body directly in the middle (measure for alignment because if it is not straight the rocket will start off at an angle). Reinforce the straw with masking tape to hold firmly in place. Also, glue in an area that is between two of the fins to avoid the fins from hitting the launching rod.

This concludes the rocket assembly. Now paint and decal your rocket as desired.

Safety When Launching:

- Wear safety goggles when launching due to possible shrapnel.
- Stand at a safe distance or behind a protective shield.
- Have a automated switch to ignite the propellant so it can be ignited from a safe distance
- Have a fire extinguisher to put out any rockets that may start on fire.
- Lounce in an open field away from trees and buildings



Rocket Project

Nick Kovalaske

Materials Needed:

(Body)

- 11"x14" Poster board
- Glue (Spray glue works best)
- Double-Stick Tape
- 3/4" Appropriately-sized dowel
- Ruler
- Knife

(Nose Cone)

- 3"x5" Note Card
- Screw-Eye

(Fins)

- 12"x1 1/2"x 3/32" modeling hardwood (maple, basswood, poplar, or balsa)
- Xacto-Knife
- Sandpaper

(Launch Holder)

- Straw

(Recovery System)

- Surveyor's Tape

Procedure

(Body):

You can buy the poster board at Wal-Mart or at any office supply store. Each sheet is 22 inches wide by 28 inches long, and it is 0.012 inch in thickness. One sheet will make four body tubes. You can use 3M Super 77 Adhesive which works very well with paper and light wood adhesion and is available at most hardware stores. Use the

double-stick tape for the first winding of the paper around the dowel. The spray adheres immediately and you don't want the dowel to become attached to the tube.

A sheet of poster board is cut into four equal rectangles, each 11 inches wide by 14 inches long. Each rectangle, rolled the long way, will make one body tube 11 inches long. Attach double-stick tape on one of the edge. The double-stick tape secures the first turn of the tube, making the spray-glue operation much simpler. Remove the dowel from the tube to keep it from getting glued. The first turn is now secured with double-stick tape. Take the paper outside and spray it with glue. It doesn't take much, but try to get an even coating. Take it back to the flat rolling-board, re-insert the dowel, and roll it up. Be especially careful to get the finishing edge of the poster board stuck down evenly and firmly. Otherwise, it will peel away and be non-aerodynamic.

(Fins):

Mark the strip at the halfway point of the strip of wood. Mark a point one inch from each end, and one inch from the centerline on the opposite side. Connect the one-inch points with diagonal lines. These are the cut lines. They are also the edge which will be glued to the rocket body tube. The root edge needs to be sanded. That must be fixed, as the edge must mate well with the body tube to glue well, and it must be squared with the flat so the fin will stand up straight. First, align the top edges. This will minimize the amount of sanding you have to do. If you have some small clamps you can try using them to hold the fins. Lay a piece of fine sandpaper on a flat surface, and rub the root edge of the fin group on it until they are all flat and even. Do the same to the other edges to make them all uniform. To align the fins on the body you can trace the body tube on a

piece of paper and draw perpendicular lines thru the center of the circle to use for guidelines. You can use Elmer's Glue to attach the fins also glue the launch holder to the side of the body.

(Nose Cone):

Start by making a mark in the middle of one long edge of a 3x5 index card. This is where the apex of the cone will be. To get the angle right, make a mark on the other edge 1 inch from the side, and draw a line between the two. Top-left side is bent down to make a partial fold you can then roll the cone. Glue the cone to the body and trim off the excess. After it has dried cut off about a $\frac{1}{2}$ " below the cone, this will be where the recovery system is located. Glue a wooded dowel, about $1\frac{1}{4}$ " long, into the cone and attach a screw-eye into the bottom of it.

(Aesthetics):

Now that you rocket is done you may want to decorate it. Use paint or decals, whatever you want, give it a personal touch.

(Finalizing):

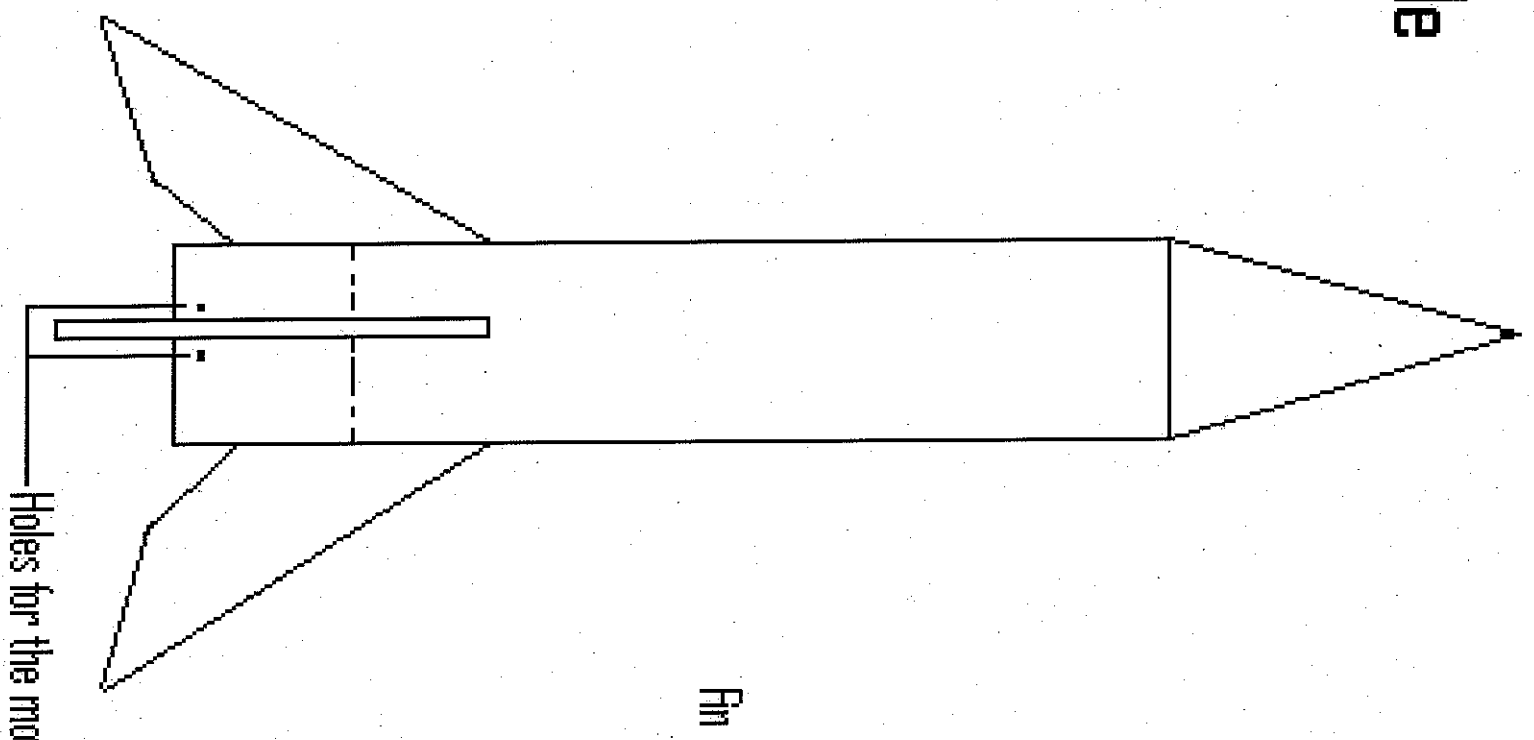
You'll need to make a thrust ring and a shock cord for the recover system to work. A length of elastic tied to a $\frac{1}{2}$ " tube made of another note card will work. It shouldn't need to be very long. The elastic will be fed thru the body and attached to the screw-eye in the cone. Glue the thrust ring in place, should be fine in the middle of the rocket. Tie a strip of surveyors tape to the elastic band and place all in tube. The surveyors tape will create drag when the rocket comes down causing it to slow down. Put the cone back in place. Measure $\frac{1}{4}$ " from the bottom of the cone. This will be where the motor is mounted and where the motor mounts will be attached, in this case a paper clip.

Put a hole through both sides of the rocket body closer together so that the paper clip will not be in direct path of the propellant.

(Safety):

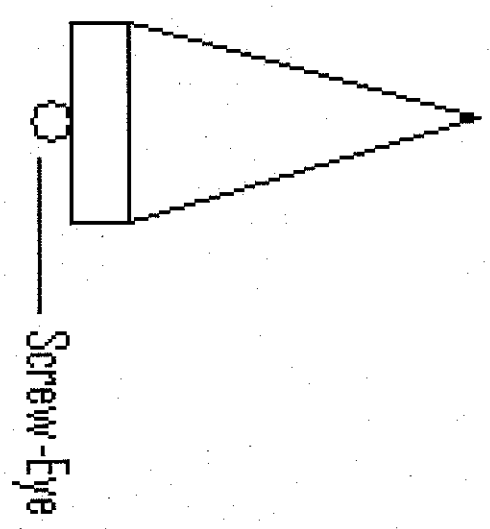
Have a fire extinguish on hand. Wear eye protection. Keep a good distance. Now go set it off.

Not to Scale

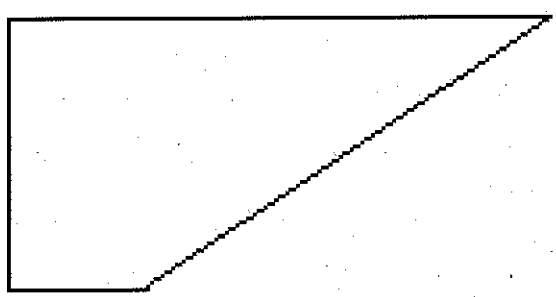


Holes for the motor mount

Fin



Screw-Eye



Rocket Design

Physics 202
5/9/07

Julia Malmborg

Materials:

- 15" length spiral wound paper tube with 1" diameter
- 4 sheets about 5" X 5" of 1/8" thick balsa wood
- Super glue
- Scissors
- Masking or duct tape
- 30 toothpicks
- Exacto knife
- Pencil, black marker
- Ruler
- Aluminum foil (approx 1.5' X 10")
- A small strip of cloth or plastic for recovery system
- Half of a plastic Easter egg
- Spray paint (any color)
- Markers (optional)
- Stickers (optional)
- Cinder block for launch pad

Procedure/ Construction:

Using the piece of spiral wound paper tube, cut length to approximately 12 inches. Insulate inside of tube with aluminum foil making several layers. Tape the ends of the tube so the aluminum foil stays in place. Stick about 7 or 8 toothpicks perpendicular directly through the rocket tube 3 inches from one end until they poke out the other side. Criss-cross them so it will create a support for the motor. Place the motor inside the tube, centered, and poke another hole on the rocket body to allow the wick to be exposed for ignition. Line the hole for the wick with aluminum foil so it doesn't catch on fire when lit. Place 7-8 more toothpicks 5.75 inches from the bottom above the motor so the motor is in place. Place super glue on the toothpicks and the rocket body so they stay in place. Once the glue is dry, double check to make sure all are secure then clip the ends of the toothpicks as close to the body as possible with scissors. There will be four fins that will be attached to the rocket body. The sides will be 3in X 3in X 1in X 3.75 in. On a piece of

balsa wood draw these dimensions with a pencil so it is in the shape of the drawing provided. Carefully cut out the fin using an exacto knife. Trace the shape of the already cut out fin onto the other three sheets of balsa wood so they are the exact same size. Cut out fins with the exacto knife. Once fins are cut out they can be attached to the rocket body. Attach fins quarterly so they are equal distance from each other. If you are having trouble, try placing the rocket vertically on a piece of paper and tracing the circumference of the tube. Then draw two lines through the center perpendicular to each other. Where the lines intersect the outside of the circle is where the fins should go. On the rocket body mark with a black marker where the fins should go based on the lines on the piece of paper. Glue the fins on the rocket body where the marks are. Make sure the fins are perpendicular to the ground so the rocket stands on it's own. Use the drawing provided to ensure the fins are put on the correct way.

Next is the recovery system and nose cone. Since the rocket itself is relatively light we will be using just a small piece of cloth to slow down the speed as it comes back down to the ground. Cut the piece of cloth about 1" X 9" or best fit for it to fit into the nose cone and rocket body. Tape one end of the piece of cloth into the tip of the rocket body. Make sure it is secure. Don't fold up until it's ready to launch otherwise it'll get stuck in the rocket and won't open up properly. The half Easter egg should fit on the top of the rocket body when ready to launch and will be used as a nose cone covering the strip of cloth. Secure it with a small piece of tape to the side of the rocket body so it can easily come off. After the rocket is assembled make sure everything is secured. Glue or tape anything that seems to be loose. Put a few strips of tape around the rocket body for support.

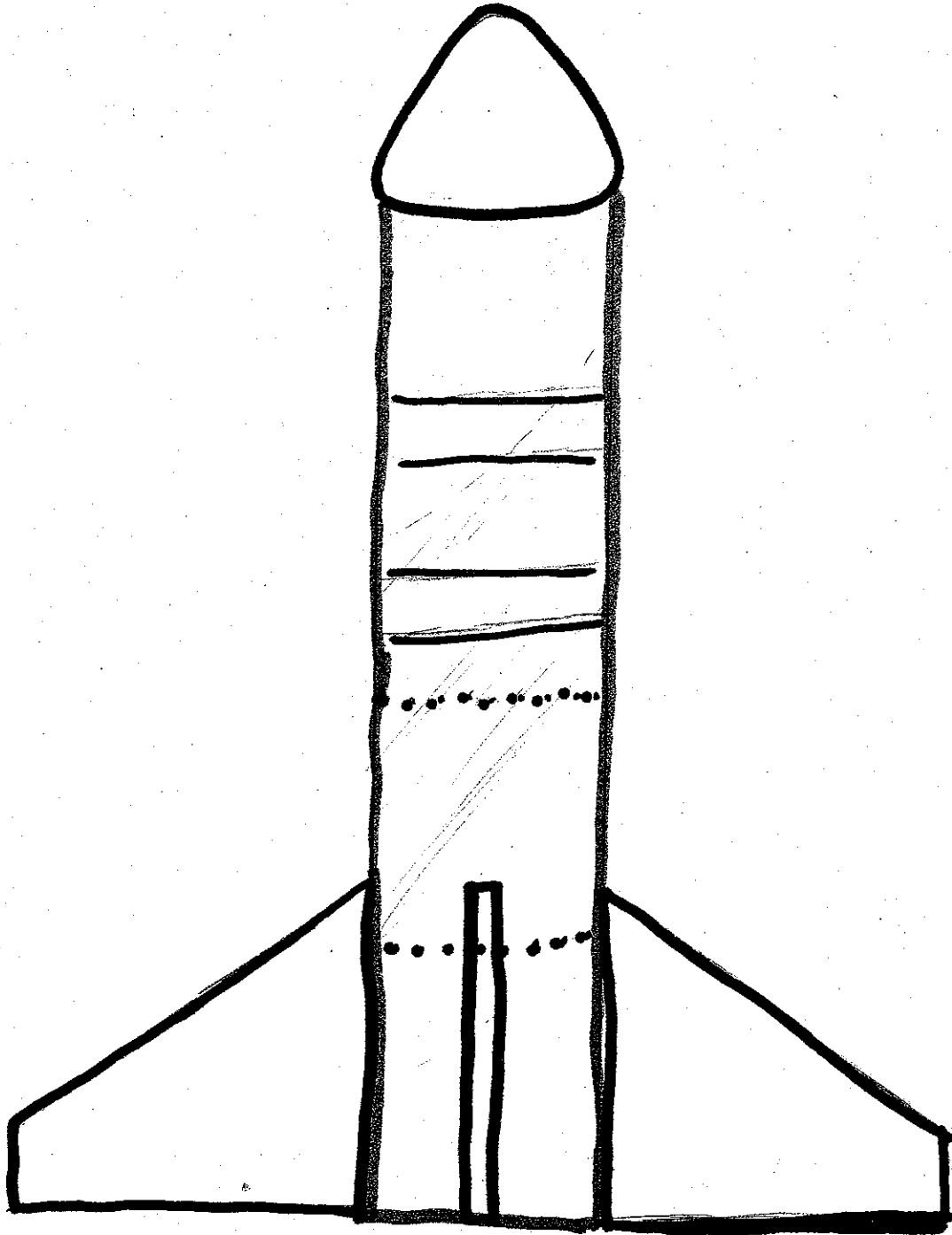
When the construction is done spray paint the entire rocket and wait until it's dry. Decorate as you wish using stickers or markers or anything of that kind but don't add too much. Keep weight into consideration. After the assembly and decoration is done the rocket will be ready to launch. As a launch pad use a cinder block on a fairly level surface so rocket will go straight up.

Safety Precautions:

Since this is a chemically propelled rocket there are some chances of it combusting. Make sure to have a fire extinguisher at launch site and also everyone is to wear safety goggles. Whoever lights the rocket should be able to run fast so they can get away immediately after ignition. Stand at least 50 feet back from the rocket when observing. Everyone should pay close attention to what's going on and when it's being lit. Enjoy!

Julia Malmberg

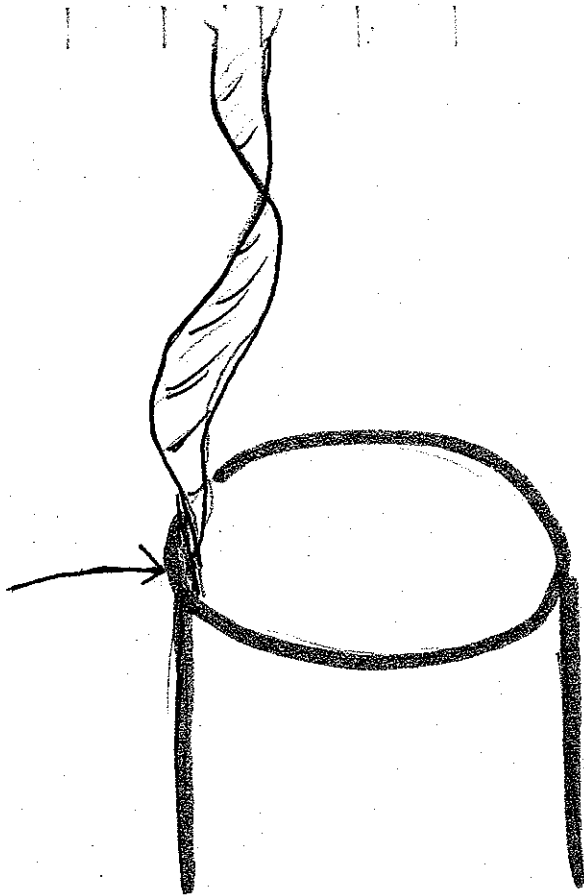
Rocket Design



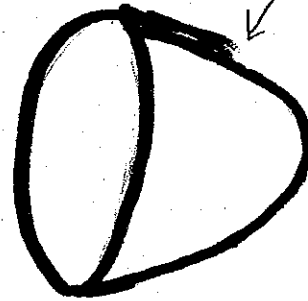
NOT ACTUAL SIZE

Julia Malmborg

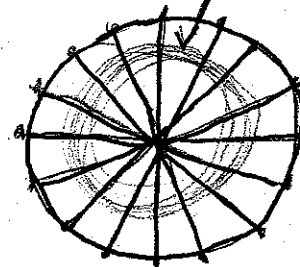
tape cloth onto rocket body



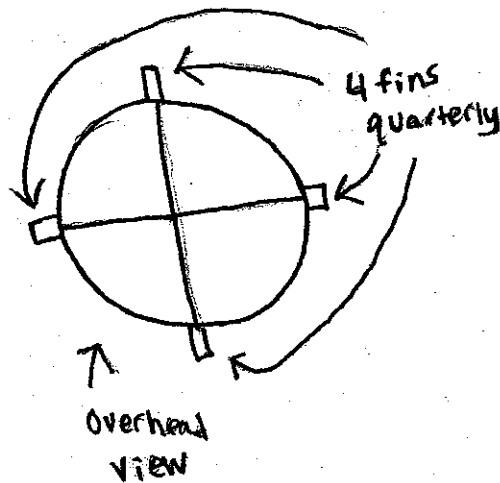
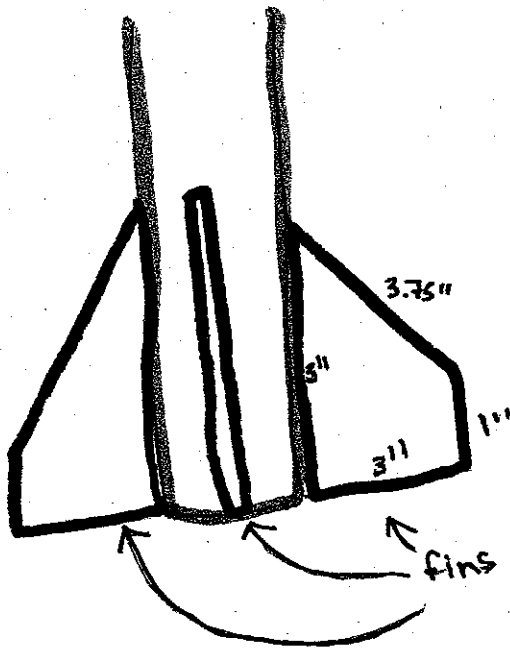
nose cone



motor



toothpicks through rocket body to hold motor



Model Rocket Design

Shawn O'Donnell

-- Materials --

- 1. Rocket Engine**
- 2. T-20 Body Tube**
 - Specifications
 - Inner Diameter .71"
 - Outer Diameter .739"
 - Length 12"
 - Weight 6g
 - Product Number T-20/12
- 3. T-20 Wood Nose Cone "B"**
 - Specifications
 - Length 1.7"
 - Diameter .739"
 - Product Number BNC20B
- 4. Balsa Bulkhead**
 - Specifications
 - Size 20
 - Diameter .71"
 - Length 1.5"
 - Product Number BH20
- 5. Basswood Sheet (for fins)**
 - Specifications
 - 3" x 24" x 1/32"
 - Product Number BAS-1323
- 6. Fine Sand Paper**
- 7. Paint**
- 8. Strong glue and/or small screws/nails**
- 9. Kite String**
 - Specifications
 - Length 30"
 - Note: include some extra length for knot tying etc.
- 10. Sport 'Chute**
 - Specifications
 - Diameter 9"
 - Product Number SC-9
- 11. (2) small eye screws**

The body tube, nose cone, bulkhead, parachute and basswood sheet can all be ordered from: www.asp-rocketry.com

-- Construction --

1. Cut the kite string into a 25" (main line) piece and a 5" (cone line) piece, don't forget to leave extra on each line for knots.
2. Screw an eye screw into the center of the bulkhead, then tie the main line to the screw. The bulkhead should be inserted into the body so that the side closest to the bottom of the rocket is 2.75" away from the bottom, and that the eye screw is pointing towards the top of the body. Securely attach the bulkhead with strong glue or small screws/nails (minimum of 8).
3. Cut out the fins from the sheet of basswood. For fin design see diagram 2.
4. Sand the nose cone, body, and fins with a fine grained sand paper until smooth then paint. After the paint has dried sand them again until there is only a thin smooth layer of paint.
5. Attach the fins to the end of the rocket body using strong glue. See diagram 3.
6. Assemble the parachute then attach the free end of the 25" main line to the parachute's shroud lines. About 3-5 inches down the main line from the shroud lines tie one end of the cone line.
7. Attach another eye screw into the center and bottom of the nose cone. (There should be a predrilled start for the eye screw in the wooden dowel that will be with the cone) Tie the free end of the cone line to the eye screw, and insert the chute into the top of the rocket body and put on the nose cone. (If the nose cone fits tightly sand it down until it fits fairly loose)
8. Insert the rocket engine into the bottom of the rocket. Wrap masking tape around the engine if it does not fit securely.
9. Find at what point on the body that the rocket will balance (horizontally). This point is the rockets center of mass. If this point is behind the center of pressure you can add mass to the front of the rocket or increase the size of the fins until the center of pressure is behind the center of mass.
$$A(cp) = D(nose) * A(nose) + D(body) * A(body) + D(fins) * A(fins)$$
10. You can use any small diameter metal rod stuck in the ground for launch as long as there are tubes on the side of the rocket that can fit over the rod. There are also launch setups that can be purchased from www.asp-rocketry.com.
11. **Safety:** When launching stand a safe distance away, base this on the engines possible explosive power.

Figure #1

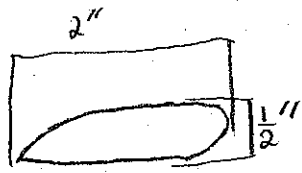
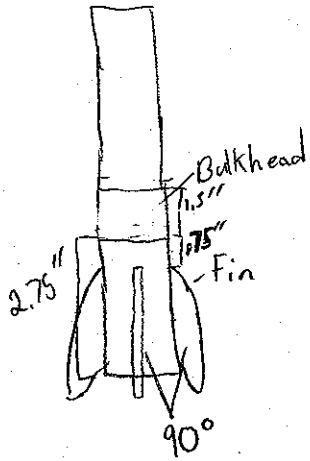


Figure #2



Rueben Hoffman

Model Rocket Body Design

Material List:

1-2 Cardboard Tubes, 12'' long, 1 - 1½'' in diameter

Plastic suitable for recovery shoot (garbage bag, etc.)

Cardboard, straight and capable of being cut

Cardboard/Notecard material for the nosecone

Fishing Line

Carpenter's/Insulator's foam

Duct Tape

Paper Punch Reinforcers (office supply)

Extra Tissue/Cloth/Toilet Paper

Metal Clip (if necessary)

Construction Instructions

For the body: use an appropriately sized cardboard tube

For the fins: cut four stripes of rectangular cardboard, roughly 1'' x 2-3''.

remove an equal triangular segment from the "upper" edge of the fin. Apply to the body using Duct Tape and/or glue; must be steady without movement. Secure them to the lower end of the body with a slight tilt parallel to the body. Use the same directional tilt for each fin; this will form rifling.

For the motor attachment: apply carpenter's foam to the bottom of the body, filling it to a depth of 4-5'', after hardened cut out a hole for the placement of the rocket,

leaving leeway on either side. Place the motor in the hole, and secure using another application of foam around the motor. Hold the motor straight as it hardens. Optionally, a metal clip may be applied to the hole first, with the purpose of preventing the motor from leaving the rocket in either direction. If it is applied, it will need to be secured to the rocket body either at the base or through the walls, perhaps both. To reuse, the foam may be recut and applied if necessary.

For the recovery: cut a circular sheet of plastic of an appropriate type approximately 6'' in diameter (more may be necessary depending on the amount of foam used earlier). Make 6 holes at least $\frac{1}{2}$ an inch in from the edge at the same radius from the center. Apply a paper punch reinforce to each side of each hole to make them sturdy. Tie a length of fishing line from each hole, which must then be attached to one central line/twine. The resulting lines going to each hole must be the same length, approx. 5''. secure the central line to the inside of the top of the body, at a depth roughly equal to the radius of the shoot using duct tape, and further secure it by application of carpenter's foam. The central line must be long enough to stretch from the securing point to 2'' above the top of the body, so the shoot may deploy. It is acceptable to punch a hole in the side of the body to secure it to if this fails to secure.

For the nosecone: using another length of cardboard tubing or firm paper, cut out, fold, and staple/duct tape together a cone for the nose. This may be of nearly any shape, preferably longer than it is wide, and wider around than the top of the body. Using remaining cardboard tubing, cut a ring off the end, roughly 2-3'' long, and widen it by cutting it to form a strip, then apply duct tape to create a ring slightly wider than the body, wide enough to fit around it snugly. Cut a circle of cardboard of the same size of

the new ring, and secure it to said ring at one end by use of duct tape. Punch a hole in the center of this circle and attach a length of fishing line long enough to stretch from the top of the body to the securing point of the shoot. The ring formed must be smaller in diameter than the cone formed earlier. Attach the new ring to the cone with the circle of cardboard facing upwards by use of carpenter's foam in the tip of the cone and duct tape around the edges of the ring. The resulting nosecone should fit snugly over the top of the rocket, leaving a lip around it to catch air which will be used to deploy the shoot. The nosecone must point straight upwards when applied to the body for straight flight. Secure the other end of the nose cone line to the base point of the shoot line where the six peripheral shoot lines meet.

Packing: take hold of the center of the shoot and pull lightly downwards along the shoot and lines, making it able to fit. In this shape, rest the shoot inside the rocket body with the peripheral lengths beneath it and the lead line along side it. Place the nosecone snugly atop the top of the body, with it's line along the same side as the central line. When fired, after reaching maximum altitude, the drag of the air will pull the nosecone off thanks to the lips. When this occurs, the trailing length will draw the shoot up and out, which will deploy and carry the entire structure to the ground.

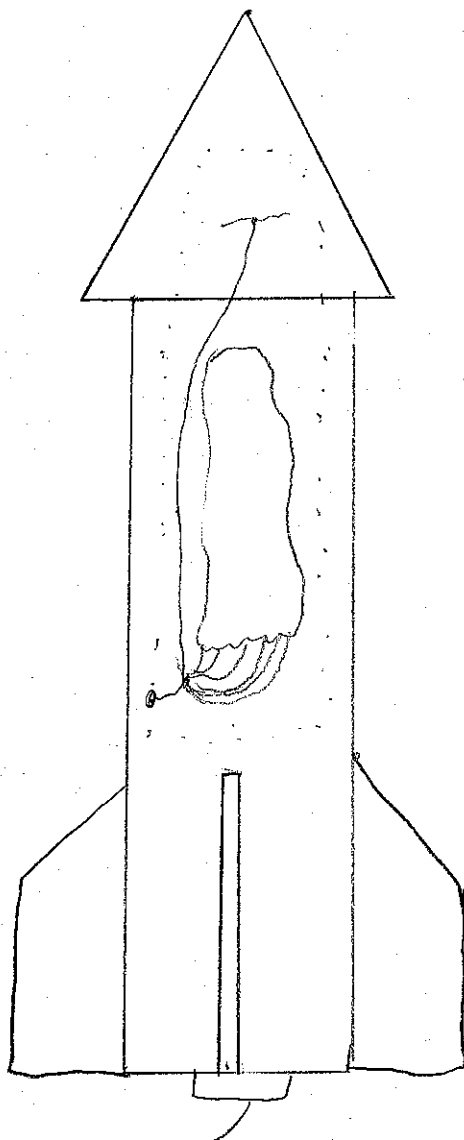
Cosmetics/Extras: if any holes were punched in the body to secure items, wrap duct tape around them to reduce drag and hold them steady. The entire thing, motor excluded, may be spray painted, and designs added to taste. Stickers etc. may also be applied.

Safety: Be sure the engine, body, and nosecone all point in the same direction to

assure a straight flight. Stand away when launching. Clear the surrounding area (don't use in an urban setting, etc.). Use appropriate safety precautions for the type of motor.

Rocket Design

Member



Nosecone

Keuben

