Simple Water Rocket & ?Sport Cap Launcher

The following photos and text document my method for making a very simple, but very high performance water rocket and launcher.

500 mL Sprite Bottle Rocket

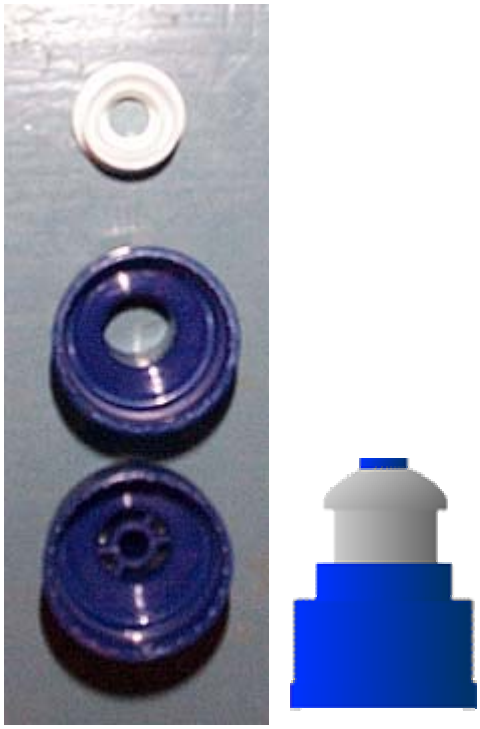
Here is a completed rocket, constructed by my son, an 8-year-old cub scout, from a 500 mL Sprite bottle. The tube fin (thanks goes to Clifford Heath) is made from the parallel center section of a drinking water bottle. The easily replaceable (and sacrificial) nose cone is made from its top. The fin is attached using three wooden "popsicle" sticks held on with double-sided foam tape (my innovation?try it, you?ll like it)?this is exceptionally strong and light, yet has some give to it; almost impossible to break. The nose cone is attached with clear packing tape for easy replace ability. Make sure to align everything carefully so your rocket goes straight up! For a simple parachute recovery system Click Here. See links to "other sites," especially Robert Youens, for more recovery ideas.

Why this design? 1. IT'S EASY 2. For stable flight, a rocket's center of gravity (CG) should be in front of its center of pressure (CP). To achieve this, the tube fin trails behind on struts to put the CP further back, and nose cone (more mass) is added to put the CG further up.

"Sport Cap"

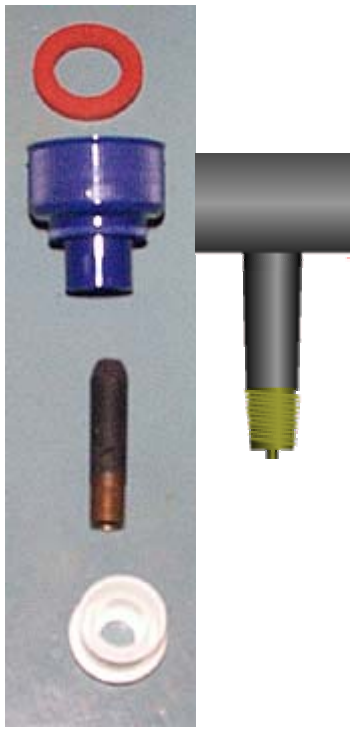
My second innovation, and the one I'm most proud of, involves using the "sport cap" (may be called other things in other countries) from a drinking water bottle?make sure you find one that fits your rocket, i.e. same thread pattern, diameter, etc. I have only ever used a cap made by Alcoa Closure Systems International, Inc. (CSI) which they call a "Sports-Lok closure" Click Here (look inside of cap for U.S. Patent 5,975,369 molded in relief). Other brands of caps may or may not work, or the pressure they release at may be higher or lower?experiment at your own risk.

This plastic "sport cap" will be used to make BOTH a reduced nozzle (longer thrust duration) AND the main part of the launcher. It incorporates a built in o-ring type seal and also a mechanical grip that keeps the nipple/top from coming off easily. This tight seal, and good grip allow the higher pressure launch (100 psi or more) of a cable tie (Clark) style launcher Click Here, while maintaining the simplicity of a low pressure rubber cork launch.



Making the Nozzle

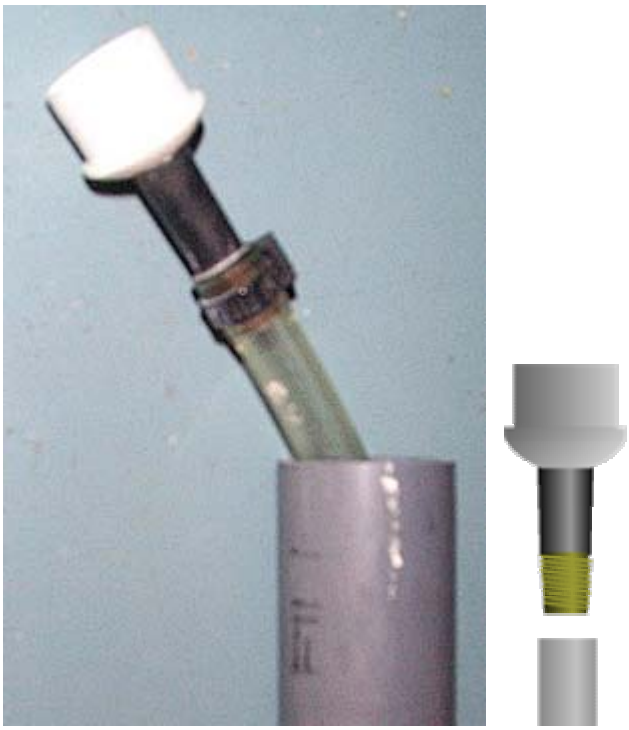
First, pull the nipple/top (shown at the top of the picture) off the ?sport cap.? This may take quite a bit of pulling and twisting, but be careful not to damage it! Next, use a pair of pliers to grasp and twist the center part of the cap (the part that plugs the hole in the nipple/top?shown at the bottom of the picture)?it should break off fairly easily. Then, using the flat blade of a screwdriver (or similar tool), carefully scrape off any remaining bits of the struts that held the center part in place. DO THIS FROM INSIDE the cap to avoid damaging the end of the ?nozzle.? Now, it should have a clean 12 mm or so opening (shown at the center of the picture).



Finishing the Nozzle & Making the Launcher

Now, you?re ready to assemble the nozzle and launcher. *First, insert a flat rubber garden hose washer into your cap/nozzle?this will prevent it from leaking under high pressure (*you might try NOT installing a washer?depending on the bottle you use, and how tight you close the cap/nozzle, it may not be necessary). Next, cut the valve stem from an old bicycle inner tube and remove its ?guts? using a small screwdriver or similar tool. If you connect the Schrader valve directly to a bicycle pump air chuck (which will depress the valve and let air in) you won't need to remove the innards?I do, because I don't connect it directly to a pump. The guts are THREADED into the valve stem. If you look down into the opening you will see a rectangular piece of brass that spans the inside walls. This is the top of the valve core, with the valve stem projecting through its center. Bicycle shops sell a special tool for removal?they would probably do it for you for free if you ask?but you can also use a tiny flat-bladed screwdriver such as are used for fixing eyeglasses/watches. Just put the screwdriver down into the valve on one side or the other of the core and turn/rotate the valve counter-clockwise. The core will unthread and come out. Insert the valve stem through the hole in the end of the nipple/top?this should be a fairly tight fit. Push the valve stem (threaded end first) through from the inside of the nipple/top?its slight taper and rubber covering will seal it against leaks.

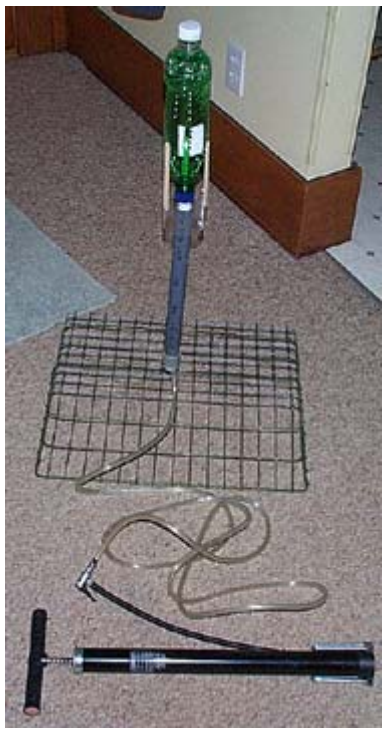
If you want to experiment with making this into a tube-type launcher (see link) substitute a metal or plastic tube for the valve stem (you will have to ream out the hole, and use a seal to accommodate a tube that will be nearly the same diameter as the nozzle).



Launcher & Hose

Finally, clamp a length (10 ft or so should do) of plastic or rubber hose to the threaded end of the valve stem (picture shows vinyl hose attached with cable tie). Run the hose through a metal or plastic pipe (pvc conduit here) that can be mounted on some sort of stable base/platform (tripods are good), or staked into the ground (see links for other ideas).

Please note that this pipe allows the use of a trailing tube fin?you don?t need to mount the nipple/top this way if you will only be using conventional fins, but it gives you more rocket design flexibility. The other end of the hose gets another valve stem clamped on?now you?re ready to go!

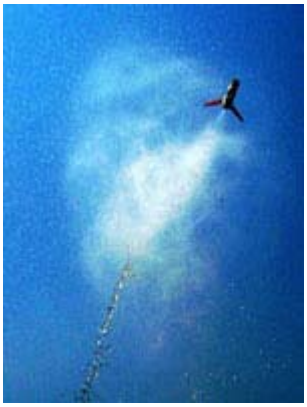


Complete System

Here is the complete system ready for launch. Attach your bicycle pump (or other gas source) to the hose. Fill the bottle with water equal to about 30% of the total volume (150 mL for a 500 mL bottle)?for effects of other fill volumes check out the simulator at Clifford Heath?s site featured in links?screw the nozzle/cap on TIGHT, and ?plug it in? to the launcher until it ?clicks? and bottoms

out. Turn everything upside down/right side up (depends on how you look at it) and make sure your rocket is pointed straight up. Start pumping (kids will need help) and the rocket will pop up a bit as the nozzle seats/latches on to the launcher, then, before you know it, your rocket will take off! Launch Video

Warn everyone to look up, as the rocket will be traveling at over 130 mph and will reach apogee at over 200 ft (again, for 500 mL bottle) in a matter of seconds. If you are using a ?lawn dart? recovery watch out! The rocket may hit the ground (or your head if you?re not careful; I?ve had one miss me by about 5 ft) at over 50 mph!



Up, Up and Away

Ready to build a bigger rocket? How about this one!

Be sure to get in your car and leave the area before this one comes down!