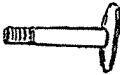


How to make a soda-bottle rocket launcher

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You need

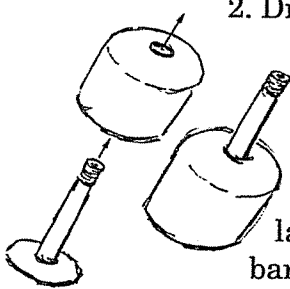
- about 6' (2 meters) of 1/2" PVC water pipe
- plumbing connectors for 1/2" PVC pipe:
 - 1 tee (two glue connections and one female thread connection) 
 - 1 elbow (two glue connections) 
 - 2 end caps (glue connections) 
 - 2 male-thread adapters 
- 1 valve stem (cut out of an old inner tube or bought at an auto parts store) 
- Barge cement or bathtub sealer
- PVC pipe glue
- some electrical tape
- 1-liter or 2-liter plastic soda bottles for rockets
- a bicycle pump with a hose (preferably a floor pump).

To build

1. Cut the pipe into 4 pieces, approximately 3' (1 meter), 1' (30cm), 1' (30cm), and 4" (10cm)—exact lengths don't matter.

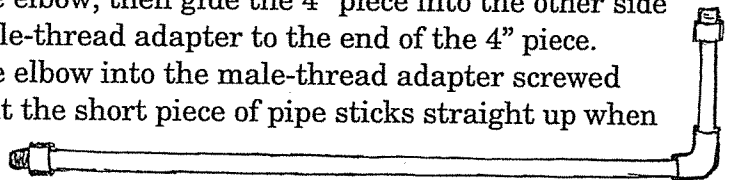
2. Drill a hole in the center of one of the end caps, large enough to put the valve stem through. Put some barge cement (or bathtub sealer) on the base of the valve stem to glue the valve stem to the end cap from the inside.

3. Use the PVC glue to glue the two 1' pieces of PVC into the tee to form the top bar of the final T-shaped launcher. Glue an end cap on each end of this bar. Screw one of the male-thread adapters firmly into the base of the tee.



4. Glue one end of the 3' piece into the elbow, then glue the 4" piece into the other side of the elbow, and glue the remaining male-thread adapter to the end of the 4" piece.

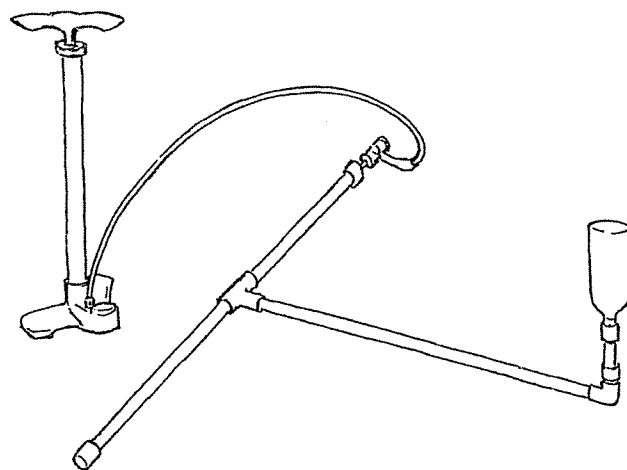
5. Glue the other end of long piece with the elbow into the male-thread adapter screwed into the base of the tee, making sure that the short piece of pipe sticks straight up when the tee is laying flat on the ground.



6. After the glue has all dried, wrap a couple of turns of electrical tape around the exposed male-threads, to make a good friction fit when a soda bottle is screwed on.

To use

1. Make sure the long pipe is firmly screwed into the base of the tee, and the short pipe sticks straight up when the tee is flat on the ground. (The launcher can be unscrewed at the tee for easier storage and carrying.)
2. Connect a bicycle pump to the valve stem.
3. Fill a soda bottle about 1/4 full of water.
4. Screw the water bottle onto the exposed male-thread adapter, trying not to spill too much of the water.
5. Pump the pump until the pressure in the bottle causes it to shoot off of the launcher (about 30 pounds/square inch).



Questions and Experiments (not just for kids)

- Where should we stand to be able to watch the rocket without looking into the sun?
- How can we estimate how high the rockets go? How could we measure it more precisely?
- Do larger or smaller soda bottles go higher?
- Does the launcher work with no water in the bottles?
- Does the launcher work if the bottles are filled completely full of water?
- What amount of water gives the highest flight?
- How could we redesign the launcher to get higher pressure in the bottles before they took off?
- How could we modify the soda bottles to get longer or higher flights?
- How can we estimate or measure the speed of the rocket as it leaves the launcher?

Safety Notes

Rockets go up 30 feet (10m), so do **not** launch the rockets indoors! The rockets are very light and pose no real hazard coming down, but they have a lot of water in them and are moving fast as they leave the launcher, and so observers should stand well back when the rocket is being pumped up. No one should start pumping until everyone else is several feet back. The rocket should always be shot straight up. Children under 10 should not use the rocket launcher without adult supervision.

There are reports on the web of soda-bottle rockets exploding, but these reports refer to a different launcher design, where the bottle is locked to the launcher. The friction-fit launcher used here will release before pressure builds up enough to be dangerous.