

# Water Rocket Launcher Assembly Instructions

John Thorburn, Tri-Basin NRD

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**Introduction:** Using water to propel a bottle into the air is both a fun activity and a good way to illustrate Isaac Newton's Third Law of Motion. That physical law states, in essence: "For every action, there is an equal and opposite reaction." The amount of water you put into a bottle adds weight to it, but also adds potential thrust. You can experiment with varying amounts of water in a bottle to try to determine the optimum thrust-to-weight ratio for bottles of a given size.

The way this launcher is designed, the bottle pops off the launcher whenever air pressure becomes great enough to pop the cork. This pressure (typically 25-30 psi) and the number of times that you need to stroke the pump to reach critical pressure for launch will vary, depending on pump size and how much water is in the bottle. Keeping that in mind, water rockets are fun and safe as long as you **do not aim them directly at anyone or get in the way of a bottle that is being pressurized with air.**

## **Materials:**

A= Wood or aluminum base plate (I used an old 12"x18" aluminum sign)

B= 4- 1" x 1/4 or 3/8 bolts with nylon lock nuts (to attach baseplate to drain)

C= 1- PVC floor drain with 1 1/4" slip connection

D= 1- 1 1/4" male (slip) x 1 1/4" female (threaded) PVC Adaptor

E= 1- 1 1/4" female (slip) x 1 1/4" male (threaded) PVC Adaptor

F= 1 to 2 feet of 1 1/4" I.D. PVC pipe (Sched. 40)

G= 1- 1 1/4" female (slip) x 1 1/4" female (slip) PVC Connector

H= 1 bottle PVC cement

I= 6 to 8 feet 5/16" I.D. polyethylene tubing

J= 2 small screw clamps

K= 1- 1 1/4" fender washer

L= 2- 2" x 3/8 screws or bolts with nylon lock nuts

M= 1- Check valve assembly (I went to a farm supply store to get these items)

A. 5/16" male (barbed) x 3/4" male (threaded) connector

B. 3/8" O.D. ball check valve

C. 3/4" female (threaded) x 1/4" male (barbed) connector

D. #4 rubber stopper with single hole (part# P31907B at [Kelvinelectronics.com](http://Kelvinelectronics.com))

N= 1- Long air valve stem for truck or tractor tire (I got this from a Co-op tire repair shop)

O= 1- 1 3/8" O.D. (1/2" I.D.) "fender washer"

P= 1- Air pump (I use a manual foot pump with a clamp-type connector that cost about \$8)

Q- two to four tent stakes, or some other form of anchor for base plate

Total cost of materials (excluding air pump)= \$25-\$30

### **Tools:**

Hack saw  
Sharpie-type permanent felt tip marker  
Ruler  
Tape measure  
Sandpaper  
Slotted screwdriver  
Sheetrock or box knife  
Electric drill with 3/8" and 3/4" bits  
Tire valve extractor

### **Assembly (for ages 12 and up):**

1. Draw a center line along the length of the PVC pipe (F) with a Sharpie -type marker. Draw a line at a right angle to the centerline EXACTLY 3 3/16" from one end of the pipe (mark end used for measurement with an arrow or x). Make two marks 3/8" on either side of the centerline along the line just drawn. These are drill hole marks.
2. Drill two 3/8" holes all the way through the PVC pipe (F) on the marks indicated. A vise is helpful for this job. A drill press is ideal.
3. Drill 3/4" hole along center line about 5" to 6" from the same end used to measure from on step #1. The air hose will go through this hole.
4. Glue connector (G) to marked end of pipe using PVC cement (H).
5. Glue slip end of adaptor (E) to other end of pipe using PVC cement (H).
6. Thread poly tubing (I) into pipe (F) through hole drilled in step #3, then pull out through end of pipe with connector (G) attached.
7. Place one screw clamp (J) over hose end that you threaded through pipe in step #6, then thread fender washer (O) insert 5/16" male barbed end of check valve assembly into hose, then tighten hose clamp over end (see figures 3,4).
8. Insert screws (L) through holes drilled in pipe (F) during step # 2. Make sure that poly tubing (I) runs between the screws, not off to the side. Tighten nuts just so they won't come loose. Screws (L) should still be able to move freely. These screws act as stops to prevent the check valve assembly from slipping down when bottle is on launcher and air is pumped into it (see figure 2).
9. Cut off base of tire valve stem (N) with hack saw, sand off burs. Remove valve from stem with valve stem extractor if necessary (the check valve assembly maintains air pressure in bottle, see figure 5).
10. Slip screw clamp (J) over other end of poly tubing (I). Slide cut-off end of valve stem (N) into tubing, then tighten screw clamp over end.
11. Set drain (C) on workbench upside down (so collar is flat on bench). Glue PVC Adaptor (D) onto bottom of drain hole using PVC cement (H).
12. Drill four 3/8" holes in corners of collar of drain (C). Use floor drain as template to mark holes in base plate (A). Drill 3/8" holes through base plate. Insert screws (B) through holes in drain collar and base plate. Tighten nuts (See figure 1).
13. Drill two to four 1/4" holes through base plate. These are for tent stakes to secure base plate on ground.

14. Screw adaptor (E) onto adaptor (D) on base plate. Don't overtighten! You will want to be able to take it apart for storage. Anchor base plate in ground with tent stakes or similar anchors.
15. Attach air pump (O) to valve stem (N) (See figure 6).
16. Put water in a pop bottle, pull check valve up through pipe and push plug into bottle neck. Slide bottle neck with check valve attached down into connector (G).
17. Pump air into bottle until it launches.



# Water Rocket Launcher Assembly Illustrations



Figure 1- Example of base plate with drain.



Figure 2- Result of steps 1-8.



Figure 3- Check Valve Assembly with plug.



Figure 4- Check valve partly disassembled.



Figure 5- Valve stem to connect to air pump.

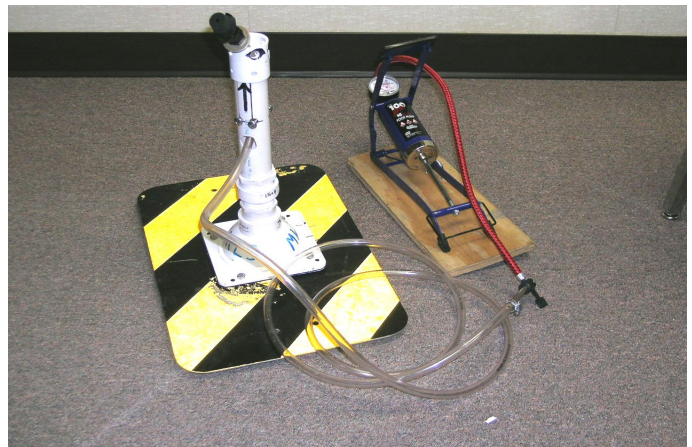


Figure 6- Completed launcher with pump.