

NEW ROADS

MAGAZINE

DIY SCIENCE WITH CHEVY:

Quick-N-Easy Water Rockets

Inspire others to build their own water rocket by sharing photos and videos of yours with [#ChevyLove](#).

WHAT YOU'LL LEARN:

- Pressure
- Working/reaction mass
- Burn time

BUILD TIME:

Under 10 minutes

MATERIALS & SUPPLIES:

- Bike Pump
- Jug of Water
- Electric Drill
 - Ruler
- Tire Stem
 - Cork
- Duct Tape
 - Pliers
 - Marker
- Utility Knife
- 20-oz. Plastic Bottle
 - Garden Stake
 - 3" Mailing Tube

This series is designed for children ages 7–13. All activities should have adult supervision with proper safety precautions. We recommend always wearing gloves and safety glasses while conducting experiments.

BUILDING YOUR WATER ROCKET:

STEP 1: GET A TIRE STEM

Bike shops and tire stores are a reliable source for old tire stems. Tell them that broken stems are OK. A broken car tire stem usually just has its bulbous end snapped off (that's the round end on the top of the stem; you don't need it anyway). A broken bike stem is one that's been separated from the bike tire inner tube, which will save you some work later. If the bike or car tire stem is missing its valve, don't worry; we don't need it.

STEP 2: TRIM YOUR TIRE STEM (IF NECESSARY)

If you're using a bike tire stem, cut away all of the surrounding rubber. A car tire stem can be used as-is—although if the bulbous rubber end is in the way, you can cut it off with your utility knife.

STEP 3: DRILL YOUR LAUNCH PLUG

To build your launch plug, cut the cork in half horizontally, and then drill a hole through the middle big enough for the tire stem. Cork is a little trickier to work with than other materials, since it tends to tear apart and is hard to grip. Test to see which end of your cork fits best into the bottle you have, and measure 1/8-inch from that end of the cork. Mark this "safe point."

DRILLING TIPS & SAFETY: For safety's sake, hold the cork with a pair of pliers. Running the drill fast, drill a 1/4-inch hole through the cork. If you're using a bike tire stem, this should be fine (although you may need to generously ream the hole, or even bump up to the 19/64-inch bit). For a car tire stem, switch to the 3/8-inch bit to expand the hole.

STEP 4: ASSEMBLE YOUR LAUNCH PLUG

Insert the threaded end of the tire stem into the "safe point" end of the cork and push it through. It should be a snug fit (important for pressurizing the bottle). Twisting as you go will help. All of the brass threads should be pushed entirely through the cork. (You can use a utility knife to trim down the cork if it ends up being a little too long.)

STEP 5: BUILD A LAUNCH TUBE

Cut a 7-inch length from the mailing tube or canister and duct tape the garden stake to its side. While a tube is not strictly necessary, if you have a stand-up style bike pump, having a launch tube frees up both hands to operate the pump.

STEP 6: PREPARE TO LAUNCH

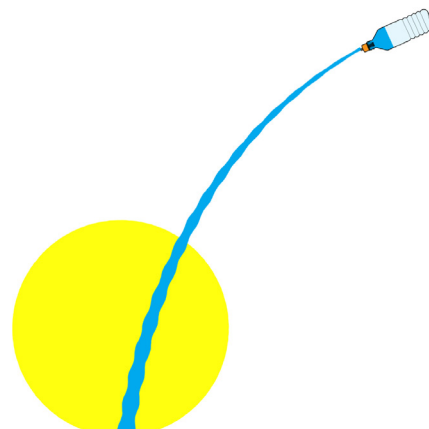
You're ready to launch! Head outside with your bottles, launch tube, launch plug, bike pump, and a jug of water. Make sure you have plenty of space and a clear landing zone for your rocket (no one wants to get hit by a water bottle). Stick the launch tube stake into the ground, leaving enough open space at the bottom for you to attach the bike pump.

STEP 7: CHARGE YOUR ROCKET

Fill the bottle one-third full with water, and then stick the launch plug in the mouth of the bottle so that the threaded end of the valve stem sticks out. Insert the plug at least to the safe point or up to halfway into the mouth of the bottle.

STEP 8: PUMP AND LAUNCH!

Slide the rocket into the launch tube, connect the pump to the valve stem, and start pumping vigorously. After a dozen or so pumps (depending on the quality of your pump) the cork will pop, and we have liftoff!



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BUILDING THE BETTER ROCKET:

Because the force driving the rocket depends on the *pressure* of the water spewing out the back, you can improve flight time and distance in two ways: increase the pressure in the bottle or make the water transfer momentum more efficiently.

INCREASE THE PRESSURE

Start by experimenting with driving the cork farther into the bottle and using different launch angles. A deeper cork requires more pressure to pop, so you can expect longer flights. The limiting factor here is your pump; even a leaky old basketball pump will be able to launch a rocket whose plug is inserted only to the safe point. As you drive the cork deeper, you'll need more pressure.

WATER TRANSFER MOMENTUM

You can also experiment with making the water a more efficient *working mass* (also called *reaction mass*) for accelerating your rocket. Start by trying different volumes of water. There's a sweet spot: Having too little water means a disappointing thrust, but having too much makes the rocket too heavy to overcome the weight of its own fuel. Denser propellant, on the other hand, will give you greater thrust (because it will transfer more momentum) without increasing the "*burn time*" (the amount of time it takes to vacate the heavy fuel, which is weighing down your rocket). You can make the water denser by adding dish soap or salt.

MORE ROCKET TIPS

Of course, you can also improve the rockets themselves. The most obvious way is to move up to a larger-size soda bottle. Regardless of bottle size, though, if you're interested in maximizing height, you can add a simple nose cone and stabilizing tail (the nose cone is cut from the top of an identical bottle and glued in place). You can glue on stabilizing tail fins, or experiment with ribbons dangling off the end of the bottle, which create stabilizing drag (like a kite's tail).