

# Tech News

## Rocket Launchers

Today in Tech Club we'll build soda-bottle rocket launchers, following the instructions I wrote a few years ago

<http://www.soe.ucsc.edu/~karplus/abe/soda-bottle-rocket.pdf>

There is one small change from those instructions: I now have the students put the valve stem into a screw-on cap, so that replacing or repairing the valve stem is easier (that is the part most likely to fail).

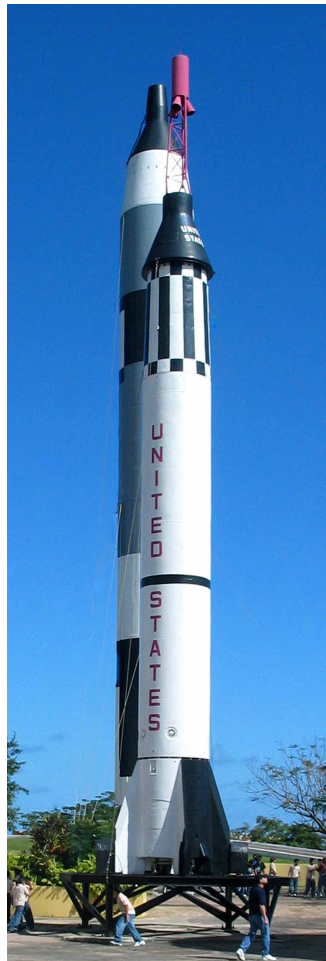
This is the first project in Tech Club with a materials fee: the materials for a launcher cost \$6, including a roll of electrical tape for the friction-fit release.

Rockets are always a popular science project, because it is neat to watch them take off. They are also an excellent demonstration of the conservation of momentum (Newton's Third Law).

### Momentum

The momentum of an object is its mass times its velocity. When the bottle is sitting on the launcher, filled with water and air, its momentum is 0. When the bottle releases from the launcher, the total momentum of the bottle, water, and air remains 0. Because the water (which has most of the mass) is rushing backwards out of the bottle at high speed, the bottle has to move even faster in the opposite direction to keep the total momentum at zero.

The faster the rocket goes, the higher it will get before the acceleration of gravity brings the speed down to zero.



*This rocket is **not** a soda-bottle rocket, but the real shell of a US missile in Science Park near San Juan, Puerto Rico. Unfortunately, Science Park is badly named, as there is not much science to be found there.*

If you fill a bottle too full, then it will still have a lot of water in it as it takes off, and it will not need much speed to keep the momentum zero. Therefore, it will not go very high.

If you put little water in the bottle, the water will come out very fast and the bottle will have little mass, but the momentum of the water will be limited by its mass, and again the bottle will not go very high. Putting in too little water is less of a problem than putting in too much, because the air also has some mass.

### Release mechanism

These launchers are designed to have the rocket take off when the pressure in the bottle gets high enough to overcome the friction of the neck against the tape on the launcher. This varies from a gauge pressure of about 20 pounds per square inch (psi) to about 40 psi (140–280 kPa in SI units). Other launcher designs use a locking mechanism that allows higher pressures.

### WWII/tech comic

I found this cartoon at <http://xkcd.com/c257.html> and thought it particularly appropriate, since the 5th and 6th graders are studying World War II when the Navajo code talkers were used. The xkcd webcomic often has amusing tech-geek comics, but comes with this warning:

This comic occasionally contains strong language (which may be unsuitable for children), unusual humor (which may be unsuitable for adults), and advanced mathematics (which may be unsuitable for liberal-arts majors).

