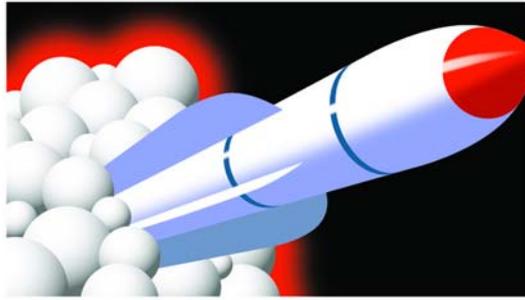


# Build An Air-Powered Bottle Rocket

**GRADE:** High school

## PURPOSE

3...2...1...Get ready to blast off into a highflying and even higher excitement activity. Your students are going to design, build, and launch an air-powered rocket. This will be an exciting way for students to learn about aerospace engineering.



- Duct Tape
- Glue sticks
- Low-temperature glue gun
- Water
- Clay
- Plastic garbage bags
- String
- Safety glasses

## KEY TERMS

**Newton's First Law** – Objects at rest tend to stay at rest, and objects in motion tend to stay in motion at a constant speed in a straight line unless acted upon by an unbalanced force.

**Newton's Second Law** – The net force acting on an object in a given direction is equal to the mass of the object multiplied by the acceleration of the object in the same direction as the net force.

**Newton's Third Law** – The force of one object (object 1) acting on another object (object 2) is equal in magnitude and opposite in direction to the force of the second object acting upon the first.

**Center of Gravity (CoM)** - The point at which the entire weight of a body may be considered as concentrated so that if supported at this point the body would remain in equilibrium in any position. (0). Same location as center of mass.

**Center of Pressure (CoP)** - The point on a body where the sum of the total pressure acts. Pressure acting on a surface causes a force. The point at which the sum of these forces, from the various surfaces of the body is the CoP.

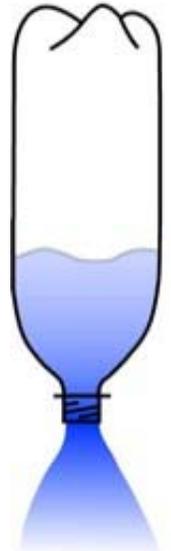
## EQUIPMENT

- 3 Altitrak altitude finders  
[http://www.sciencekit.com/category.asp\\_Q\\_c\\_E\\_756062](http://www.sciencekit.com/category.asp_Q_c_E_756062)
- 1 three bottle rocket launcher  
[http://www.sciencekit.com/category.asp\\_Q\\_c\\_E\\_439894](http://www.sciencekit.com/category.asp_Q_c_E_439894)
- 1 1/2 liter PET bottle (one per student with extras)  
[http://www.sciencekit.com/category.asp\\_Q\\_c\\_E\\_439894](http://www.sciencekit.com/category.asp_Q_c_E_439894)
- Bicycle Pump with Gauge  
[http://www.sciencekit.com/category.asp\\_Q\\_c\\_E\\_439894](http://www.sciencekit.com/category.asp_Q_c_E_439894)
- Duct Tape – One roll per 10 students
- Ghostline Poster Kit (Walmart) With 1/2" Grid Pattern
- Coroplast (Corrugated Plastic Sheets)
- Markers and Decals

- Graph Paper

## PROCEDURE

1. Form groups.
2. Introduce the bottle rocket activity.
3. Sketch preliminary rocket designs.
4. Talk about safety.
5. Give students materials to begin construction.
6. Demonstrate how to find center of mass (CM) and center of pressure (CP).
  - The Center of Mass (CM) can be found by locating the balancing point of the rocket.
  - The Center of Pressure (CP) can be found by tying a string around the rocket body so that it does not slip. Have the students stand in a wide open area and swing their rocket in a circle. If the rocket points in the direction they are swinging, it is stable. If not, have the students add more clay to the nosecone or replace their fins with larger ones. This test should be repeated until the rocket points in the direction they are swinging.
  - The CM should be closer to the nose cone than the CP.
7. Discuss launching safety.
8. Demonstrate the correct use of the Altitrak to measure the height of rockets at apogee.
9. Complete post launch documentation.



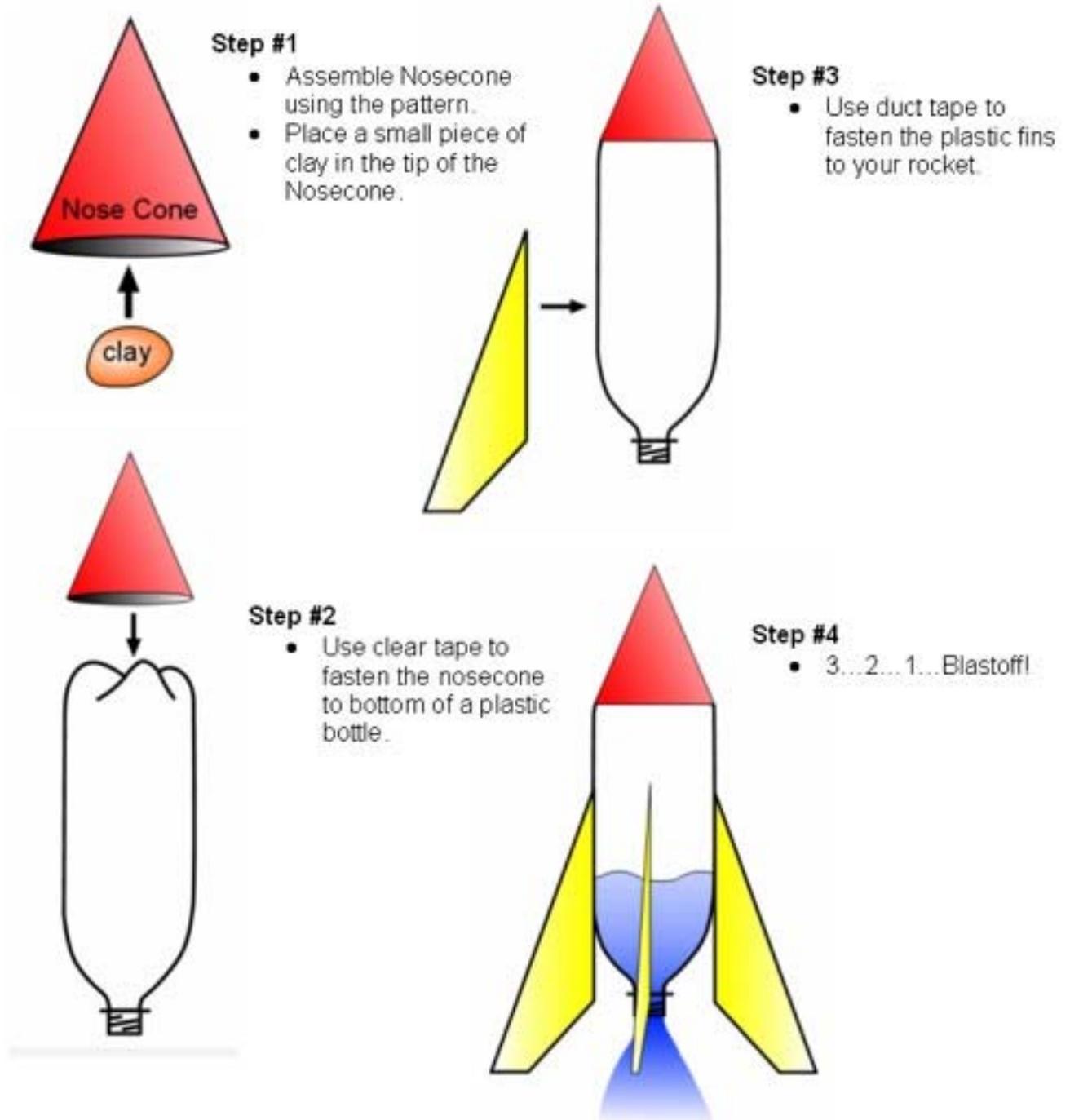
## SAFETY GUIDE

- Following these safety procedures will ensure all students safely enjoy this activity.
- Only plastic drink bottles should be used for rockets. No Glass!!
- Bottles should be retired from use after 15 launches.
- Supervise students closely when they are using rockets.

- Launch rockets in an open grassy field or athletic field away from buildings. If it is a windy day, place the launcher closer to the windward side of the field.
- As you set up your rocket on the launch pad, observers should stand back several meters. It is recommended that you rope off the launch site.
- Do not point your water rocket at another person, animal, or object. Water rockets take off with a good deal of force from the air pressure and weight from the water.
- The team member responsible for pumping air into the rocket should wear eye protection. The bottle rocket should be pumped no higher than about 50 pounds of

pressure per square inch, but never above 90 psi. Before launching, consult the following table.

- When pressurization is complete, everyone should stand in back of the roped off area for the countdown. Two-liter bottles can weaken and will explode. Bottles should be retired from use after 10-15 launches.
- Continue to count down and launch the rocket only when the recovery range is clear.
- If you do not experience successful liftoff, remember that the bottle is pressurized and may blast off when you touch it. Be careful; do not let it hit you. Never stand over the rocket.



**Nose Cone Template**

