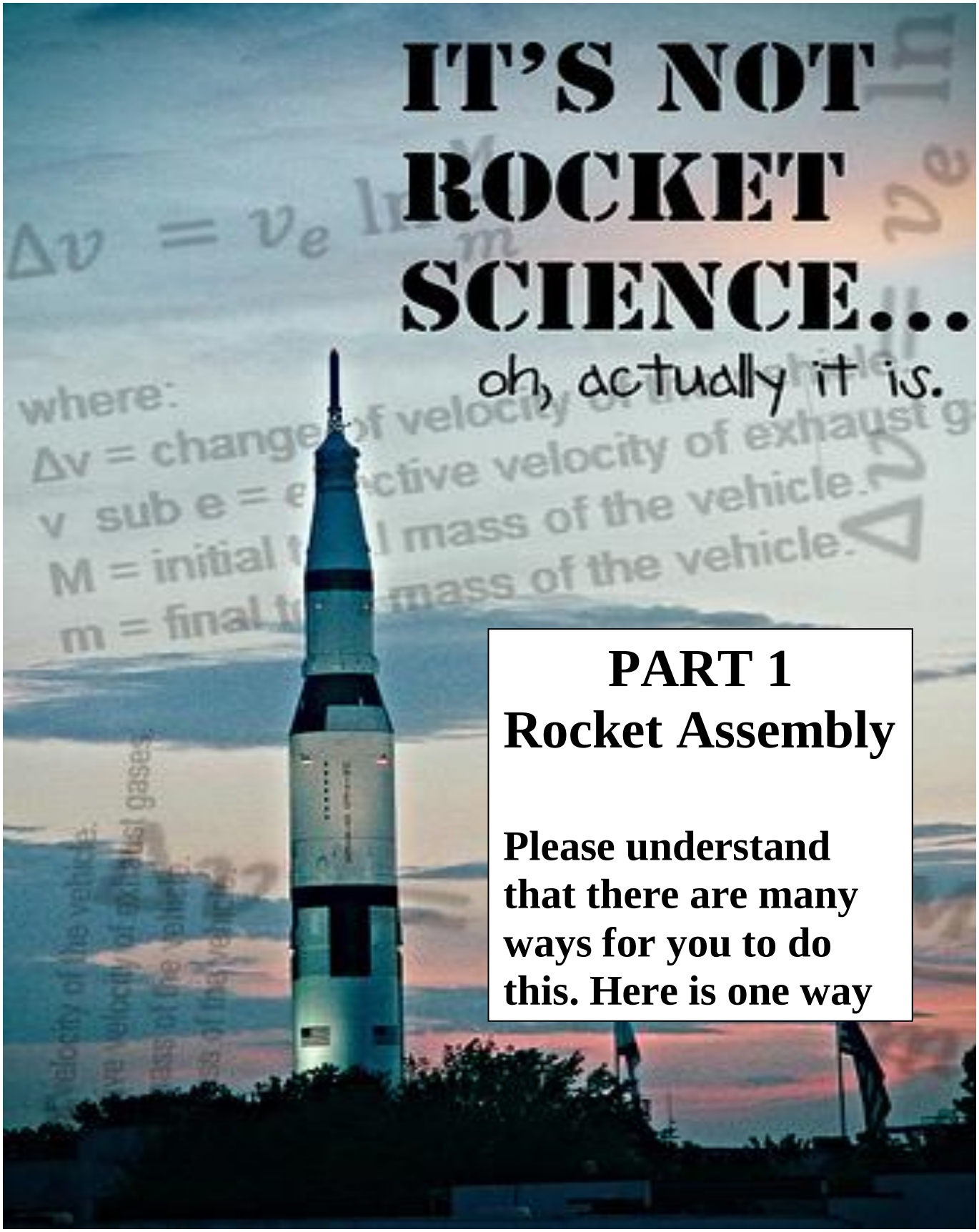
BOTTLE ROCKET LAUNCH LAB REPORT



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How Does A Rocket Work?

Where does the rocket's power come from? - When you pump your bicycle air pump fifty times, the work that you do is being stored inside the pop bottle as compressed air. Air is very springy and when it gets a chance, it bounces back to its original volume. The only way it can do that is to come rushing out the nozzle at the bottom of the rocket. You feel tired after doing fifty pumps because you have delivered some of your energy to the rocket. But the rocket now contains the energy that you have lost, in the form of compressed air.

How a rocket moves - The rocket moves forward by throwing its exhaust (the air and water) out the nozzle as fast as possible. It does not push on anything, like the ground or atmosphere. Example: if you were sitting in a small boat full of baseballs and one-by-one threw the baseballs out the back of the boat, the boat would move forward on the water. The faster you threw the baseballs out the back of the boat, the more force would be applied to moving the boat forward. This is not a very good way of moving your boat around. And indeed, it is a very inefficient way of moving a rocket around, but what else can you do? There's nothing to push on in outer space.

How a rocket goes straight - A rocket is like an archery arrow. As it moves through the air, the heavy front of the arrow falls forward and the wind pushes the fins to the back. To make the rocket go straighter, you can make the front heavier, or make the fins bigger or put the fins farther back. AntiGravity rockets all use bigger fins as far back as possible instead of more weight. That way they don't have to work as hard to travel very high, and they're much safer when they come down because they are so much lighter. Outer space rockets don't have any fins because there is no air out there to push the fins back. They use gyro-sensors to automatically aim the nozzle in different directions to keep the rocket pointed straight.

What do the guide rod and guide tube do? In the first fraction of a second when a rocket is lifting off of the ground, it is not going fast enough for the fins to keep it pointed straight up. As soon as it is off of the ground it would tumble in a random direction around it's center of gravity. Then as it picks up speed it would head off in an unpredictable direction. The guide tube keeps the rocket pointed straight up as it slides up the guide rod until the rocket is going fast enough for the fins to keep it stable.

How does the AntiGravity launcher work? The yellow bulb at the end of the filling hose is completely closed except for a tiny one-way pinhole valve. When you pump up the rocket with air, the pressure in the hose makes the bulb expand and press on the inside of the rocket nozzle. The air also pushes through the pinhole to fill the rocket. When the pressure in the rocket bottle reaches about 80 pounds per square inch, the bulb cannot hold on to the rocket anymore and it is pushed out of the nozzle by the air in the bottle. Or if you disconnect the pump from the filling hose, the pressure inside the bulb is reduced to zero and the pressure in the bottle shrinks the bulb and pushes it out. The launcher requires no special stand or bulky hardware because the rocket stands on its own fins.

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Using your Water Rocket Safely

Although AntiGravity water rockets are made to be as safe as possible to use, there are some very important rules you will need to follow for the safety of yourself and others. Most of these rules are just common sense, but nonetheless it is important to keep these in mind as you use your rocket, to ensure that you have a safe and enjoyable rocketing experience.

1. Only launch with adult supervision, in a wide open field, far away from trees, buildings, roads, people and electrical wires.

2. Never put anything in your water rocket but air, water and sometimes non-toxic handwash-type dish soap.

3. Never launch your rocket at or near people, animals, automobiles, aircraft or buildings.

4. Never launch your rocket anywhere near aircraft landing or takeoff locations or into the path of an aircraft.

5. Never launch your rocket under overhead electrical wires or during a lightning storm.

6. Stay at least 20 feet away from the rocket when it is being pressurized, and insist that all other people also stay at least 20 feet away from it, in case the bottle bursts.

7. Don't put any more than the recommended amount of water in any rocket bottle, or the rocket may lift off sideways.

8. Never launch your rocket indoors.

9. Only use a hand-powered pump to pressurize your rocket. Never use an electric or automatic pump or compressor.

10. Only use plastic *pop* bottles that have previously been used to hold fizzy pop. Never use *water* bottles because they are too thin and cannot hold the required pressure. Never use *glass* bottles, because of the danger of heavy impact or sharp broken glass shards.

11. Never climb up in dangerous places or to dangerous altitudes to retrieve a rocket. It is better to lose your rocket than to jeopardize the safety of yourself or others.

During the course of your rocket experience you will probably run across some situations that don't match any of the above. Always decide in favor of safety for yourself and others.
There may be other precautions to keep in mind that apply to specific types of rockets. These precautions will be included in the instructions for each individual type of rocket.

Bottle Rocket Lab Activity
Student Edition

OBJECTIVE:

The Student will design, construct, assemble, and launch a Bottle Rocket.

http://exploration.grc.nasa.gov/education/rocket/BottleRocket/about.htm

MATERIALS:

TEACHER provides

One (1) Launcher with trigger and lanyard.
One (1) Pressurization tube with stopper.
One (I) Plumb line with weight for launcher
Bicycle or other air pump.
Water
Dowels or straight sticks (3 or 4) 36" Long
Altimeter sheet (last page)

STUDENT REQUIREMENTS

Tape or Glue
Markers
Scrap cardboard or other fin materials
Standard plastic soda bottle (2 liters)
(if you don't have one see your teacher)

Do not use metal in ANY part of the rocket.

PROCEDURES:

1. **ASSEMBLY: (at HOME)**
   a. **Rocket (at home)**
      i. Now **design your rocket** to go higher, fly further, or have increased thrust. The following are a few suggestions to help you get started**.**
      ii. **Draw what you have in mind. Label all parts to your rocket.**

NEXT , you will need any standard plastic soda bottle with capacities of 2 liters!

2. When choosing a bottle to use for rocketry, remove the cap and check the bottle's neck ring for any cracks or defects that may fail when pressurizing the bottle.

BOTTLE ROCKET LAUNCH LAB REPORT

Preparing the Rocket Bottle

Unless you bought one of our brand new bottles for your rocket, you'll need to find an empty, used pop bottle. Make sure to only use a plastic bottle that used to hold fizzy pop. Don't use a water bottle, as it is not strong enough to hold the required pressure. Never use a bottle that has been damaged in any way, or that has any visible flaws.

1

Use a pair of snippers or a nail clipper to remove the retaining ring from the mouth of the bottle. If you don't remove it, the retaining ring can interfere with the positioning of the fins.

2 Remove the label from the bottle by gently heating the glue with a hair dryer. The label should then peel off easily. The rocket will fly higher without the extra unnecessary weight of the label.

3

This is what the finished bottle should look like. Now you are ready to begin assembling the rocket.

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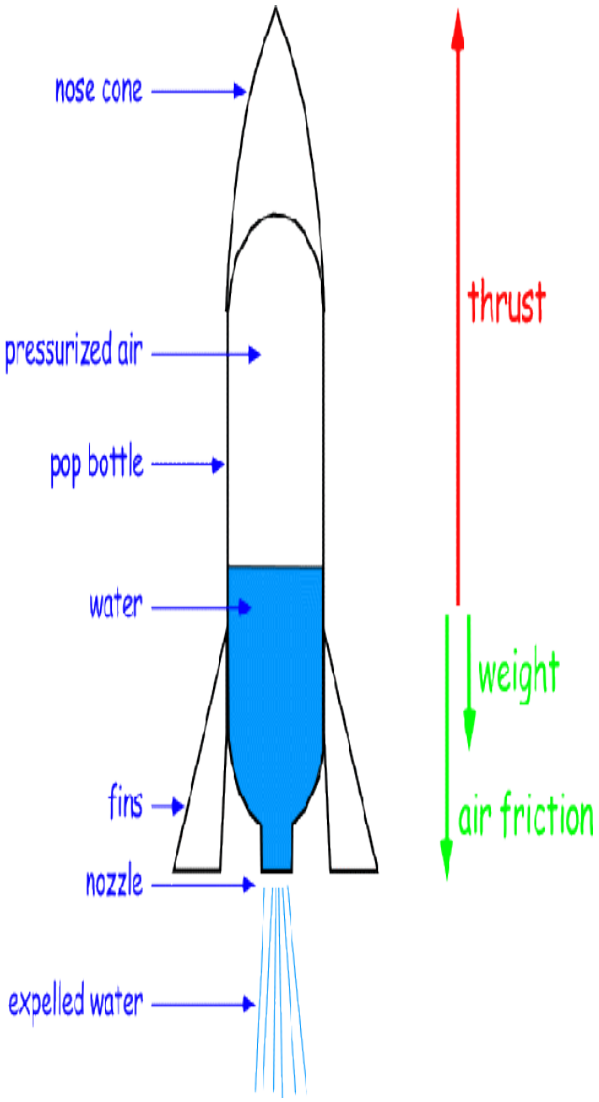
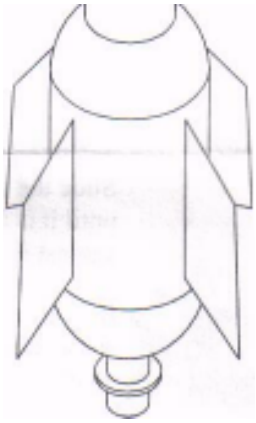
i. If the bottle looks good you're ready to' begin building your rocket**. Include the FOLLOWING on your rocket:**



3. **Fins** can also improve the stability of the rocket. Experiment with different size and shape fins. The fins do not have to be very large lo be very effective! The fins can be made using scrap cardboard from old boxes. Select your cardboard carefully, making sure that it is reasonably flat and does not have bends or folds in it. Draw your fin pattern on a sheet of paper and then use this pattern to cut the number of fins you need from the cardboard sheets. These fins can then be glued or taped to the body of the rocket. The fins could also be taped to the bottle itself! The fins work the best when placed near the bottom of the rocket, but you can also experiment by placing the fins at varying positions along the body**. *Do not use metal fins***.



4. The **nose of the rocket** is another point of consideration. The nose of the rocket must do two things: first it must streamline the rocket so the air will pass over it one more efficiently, second: it must hold the parachute or other recovery system or it must be able to absorb the impact of the rocket as it hits the ground. The nose cone can be made of cardboard rolled into a cone and then taped to the top of the rocket, or you may want to use a smaller plastic upward on the rocket.

5. The **stability** of the rocket depends upon the rocket's length. You'll find that longer rockets fly straighter than shorter rockets. Long cardboard tubes bottle turned upside down so the smooth round bottom of the bottle points make excellent bodies for bottle rockets. The larger diameter tubes often found in rolls of gift and Christmas wrapping paper make the best bodies. Smaller diameter tubes will work but they are not as strong and may not hold up as well under repeated use. Another method of constructing rocket bodies is to tape several paper towel tubes together.

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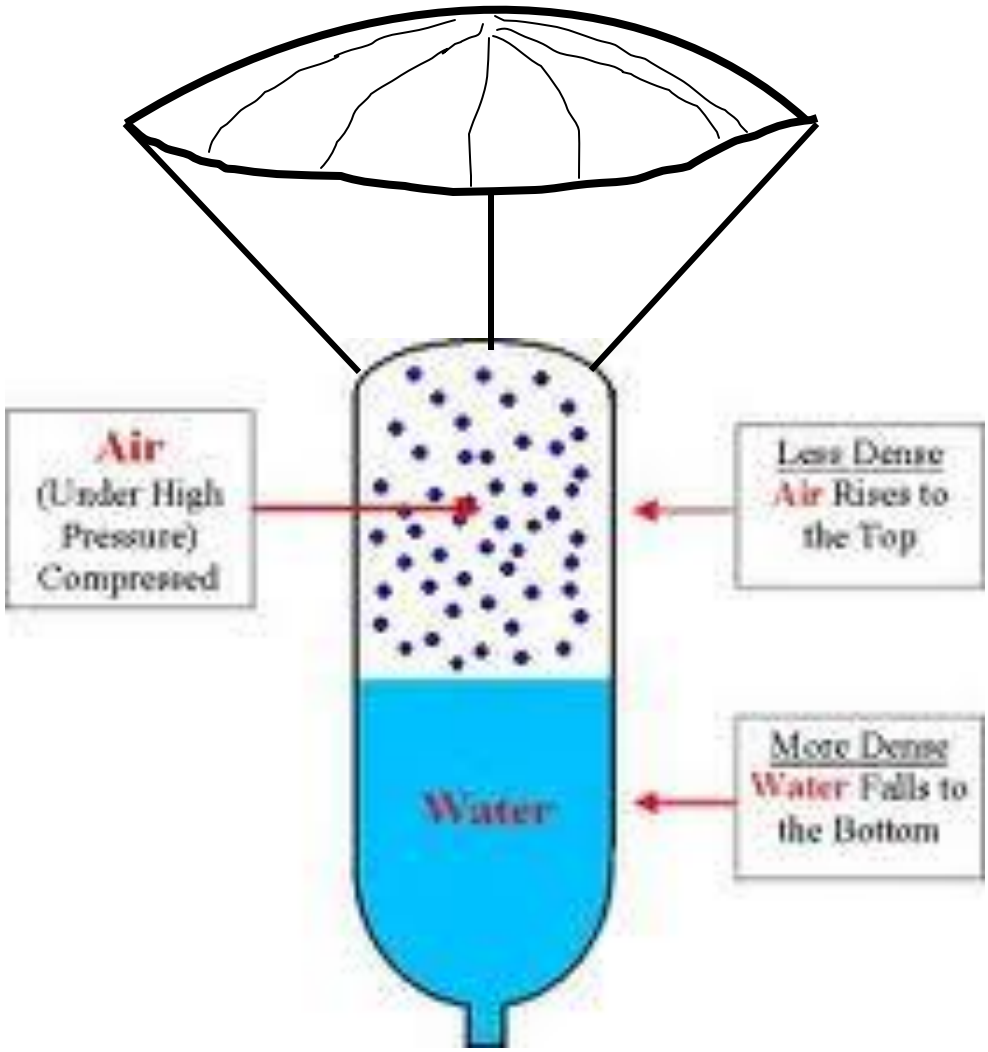
1. *The parachute can be made by cutting a circular patch from a large plastic garbage bag. Six lengths of string each about sixty centimeters long (2 feet) can be cut and taped around the perimeter of the parachute. After each string is taped in place, gather the free ends of the string together and tie them into a knot. This knot can then be taped to the inside of the rocket body tube. The parachute can then be gently rolled up and placed in the rocket body. After the parachute is loaded the nose cone can be rested on top of the rocket. Don't tape the nose cone to the rocket body if you want the parachute to an inverted nose cone, securely taped, can carry a parachute -- or even a ball. The bottom 10cm of a 2 liter bottle, well taped to the top of the pressurized bottle, has <u>lofted a real soccer ball!</u>*

DO NOT PUNCTURE the BOTTLE!!!
HOT GLUE will melt a hole in the bottle

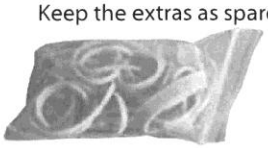


Sky Lab Rocket: Quick One-Page Instructions

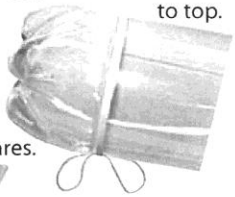
This instruction page is intended for large groups, where each participant requires a copy. On each of the panels below, starting with the bumper, begin at the left and work to the right. If your rocket is an Extreme SkyLab with the stretched bottle, it will already have the bumper installed and you can skip the bumper section. Assembly time: 5 minutes

The Bumper

This is your supply of elastic bands. There are 3 different types: short, long, and wide. Keep the extras as spares.

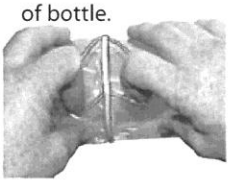


Pull both halves of long elastic to top.

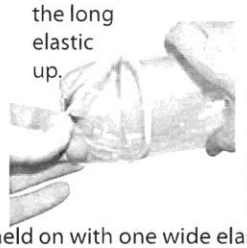


Slide long elastic under wide one.

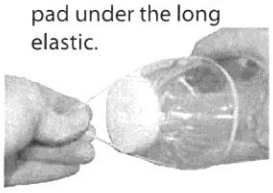
Pull one end of long elastic to other side of bottle.



Pull both sides of the long elastic up.



Slip the foam bumper pad under the long elastic.

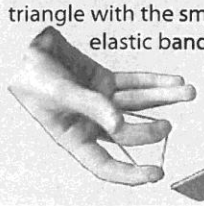


The soft bumper is held on with one wide elastic around the bottle, and one long elastic over the bumper.

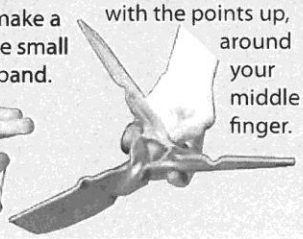
Now you're ready for the fins!

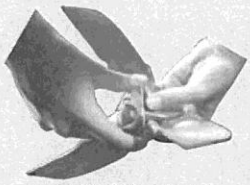
The Fins

Use your thumb and two fingers to make a triangle with the small elastic band.



With the other hand, hold the fins in an assembled position with the points up, around your middle finger.

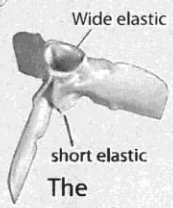




Install the small elastic on the bottom of the fins.

Transfer the fins to your other hand. Use your thumb and two fingers to make a triangle with the fat elastic.

Install the fat elastic on the top of the fins. Make sure there are no twists in it.

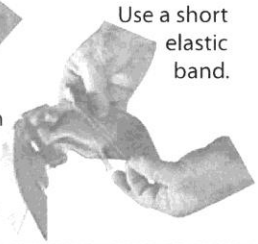


The completed fins.

Guide Tube

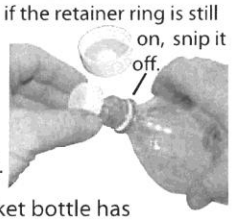
Install the guide tube in the groove on the hollow side of any one of the fins.

Use a short elastic band.



The bottle

Bring a 2-liter plastic pop bottle full of water with you to the field. From it, fill your rocket bottle with about half an inch of water. (100 ml).

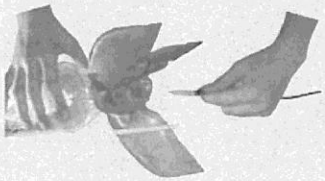


if the retainer ring is still on, snip it off.

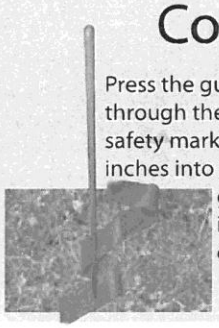
Once your rocket bottle has water in it, install the nozzle-cap on the mouth of the bottle. Screw it on firmly. Make sure to snip off the bottle's retainer ring, or the fins won't sit properly.

Push the fins onto the bottle until they click into position. **Try not to spill any water!**

Countdown!

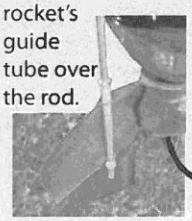


Push the yellow bulb on one end of the launcher hose into the nozzle cap. Now the water won't leak out.



Press the guide rod through the red safety marker 2 inches into the ground in a big open field.

Then slide the rocket's guide tube over the rod.



Uncoil the hose so you can stay 25 feet away.

Then hook up your air pump and pump like crazy, about 50 pumps!

Safety

Adult supervision required.

Make sure to stay at least 20 feet away from the rocket while pumping.

Launch!

Pump until the rocket launches. If you want to launch sooner, just stop pumping or disconnect your pump from the launcher hose.

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