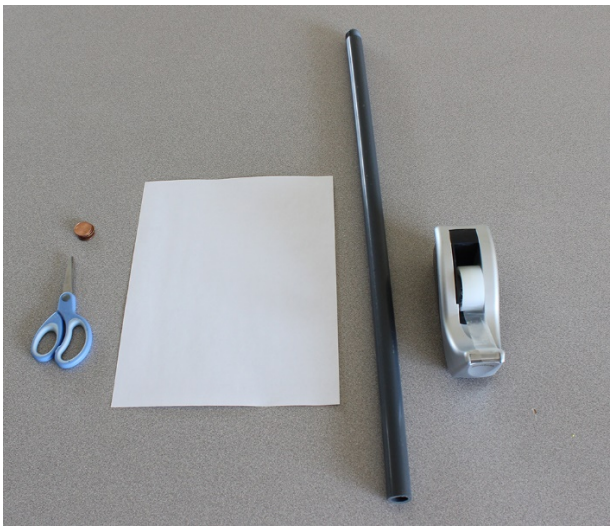
How to Make Paper Rockets



Supplies Needed

- 1/2” PVC pipe (we recommend having 3 different lengths to try between 1 and 3 ft)
- Paper
- Tape
- Scissors
- Pennies (for added nose weight if launching outdoors)
- Optional – foam darts or mini marshmallows

Step 1: Cut and Fold the Rocket Fins

Fins are optional, but so much fun to experiment with. After you have mastered a few paper rockets without fins, we encourage you to give some different fin designs a try.

Can you make the rocket rifle (spin) through the air?

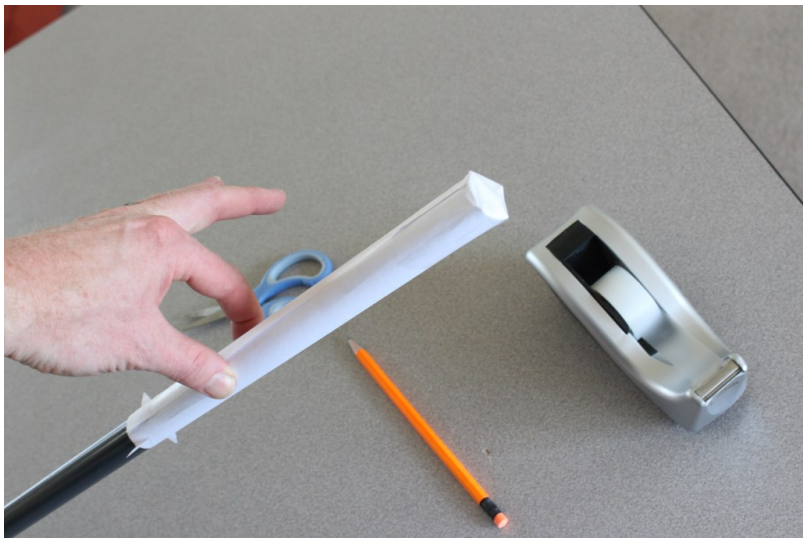
Step 2: Tape the Paper Rocket into a Tube

Roll the paper around the 1/2” PVC pipe to make a tube. The perfect rocket would be rolled nice and straight, with a good fit around the PVC pipe and slides off easily.

Step 3: Fold and Tape the Rocket Nose Cone

Fold the end of the tube over the end of the pipe. Next, tape the folded nose cone down.

To tape the rocket nose cone, slide the nose of the rocket to the end of PVC pipe so that the paper tube overhangs by about 1 inch. Use the edge of the pipe to fold the paper over, sealing off the end of the paper rocket tube. Use 2 pieces of tape to firmly hold the folded nose cone in place.



Step 4: Add Nose Cone Weight

Adding a few pennies to the tip of the paper rocket is a great way to add some additional weight to the nose cone and change the flight characteristics.

Especially if you plan to launch your rockets outdoors!

Experiment with Different Designs

Rocket science for kids gets real when you start testing and observing different designs!

Try changing these design parameters to learn how they change the rocket's flight characteristics:

Rocket Length: Try a rocket that is 4 inches long and a rocket that is 22 inches long (2 sheets of 8.5 x 11 paper taped together).

Fins: Small fins vs large fins. 3 fins vs 5 fins. Slanted fins. Straight fins…

Nose Cone Weight: How does it fly with zero pennies? 1? 2? 8? …

Tube Diameter: A large tube that fits loosely around the PVC pipe? A tube that fits tightly around the pipe?

You do not need a launcher. Just blow to launch! The best part about this experiment is that you don't need a fancy paper rocket launcher. Blow with all your might to send that rocket shooting off the end of your PVC pipe! Try laying down on your back outside to see how high you can launch the paper rockets!

Now, let's learn some rocket science to better understand what is happening here.

Fundamental Principles of Paper Rocket Design

Propulsion

Given the same air pressure or blowing force, which do you think will launch faster? A short paper rocket or a long paper rocket? Do you know why?

To understand the answer, we need to understand what is propelling our paper rocket. When you blow on the PVC pipe, the high air pressure inside pushes the rocket off the end. A short rocket quickly pops off the end of the pipe, thus getting a short push from the air pressure. A long rocket takes longer to leave the end of the pipe, thus getting a longer push. Since the long rocket gets a longer sustained push from the air pressure, the longer rocket will launch faster!

If you have some mini marshmallows, or foam darts, try shooting them with different lengths of pipe to see how length affects launch speed. If you have some mini marshmallows, or foam darts, try shooting them with different lengths of pipe to see how length affects launch speed. Hint: We like to do this experiment aiming at a wall if a soft target is not available – do not aim at people!

Short vs Long, which launches faster?

Center of Mass & Center of Pressure

For stable paper rocket flight, the center of mass must be in front of the center of pressure.

What does this mean?

Let's start with some definitions:

Center of Mass (CM): The point at which the mass for the entire rocket is focused. If you held the rocket by the center of mass, it would be perfectly balanced.

Center of Pressure (CP): The point at which the aerodynamic effects of drag for the entire rocket are focused. Like the center of mass, the center of pressure is where the aerodynamic effects are "balanced."

If the rocket design is such that the CM is in front of the CP, then the rocket will fly straight. This flight stability comes from the front of the rocket being pulled forward by the CM and the back of the rocket being pulled backward by the CP. If the rocket wobbles out of alignment, these forces straighten it back out in midair.

In other words, the CM, located toward the front of the rocket, is pulling the rocket forward because of momentum. The CP, located toward the rear of the rocket, is pulling the rocket backward because of drag. The front being pulled forward and the back being pulled backward keep the rocket straight and stable!

Phew! We sure learned a lot about rockets! Now it's time to make your own!
Post your photos and tag us on Facebook at Machane Tba!