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MINGDE RD., PUYAN, BINJIANG, HANGZHOU, CHINA.

PLAY • READ • INSPIRE

THE LEARNING BOOKLET
— FOR MY FIRST WATER ROCKET —
Read to be inspired!

PUMP INCLUDED

WARNING:
CHOKING HAZARD - Small parts,
Not for children under 3 years.

AGES **6+**



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WARNING MESSAGE

GENERAL WARNING

Before you begin, please read through the instructions together with your children. Make sure you understand the safety messages. Please keep the packaging and instructions, as they contain important information.

This kit is designed for children over 6 years of age.

CHOKING HAZARD - Small parts, not for children under 3 years.

Children should have parental supervision when assembling the product.

This kit is intended for outdoor use.

Please clean the product with a clean cloth when necessary.

WARNING: Do not aim at eyes or face.

WARNING: Do not discharge an object other than the projectile provided with this toy.

This kit was designed by using the default hand pump. The use of any other pump could lead to excessive air pressure which could damage the parts or even cause an explosion.

1 | WARNING MESSAGE





2 | **PACKAGE CONTENTS**



Package Contents



Serial	Name	Quantity	Serial	Name	Quantity
1	Rocket body	1	6	Gasket	1
2	Pump	1	7	O-Rings	2+1(spare)
3	Air tube	1	8	Fin support	1
4	Fins	4	9	Sticker	1
5	Nozzle	1			

Necessary but not included

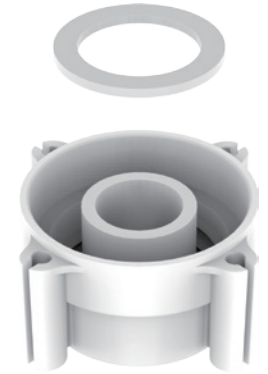


Water

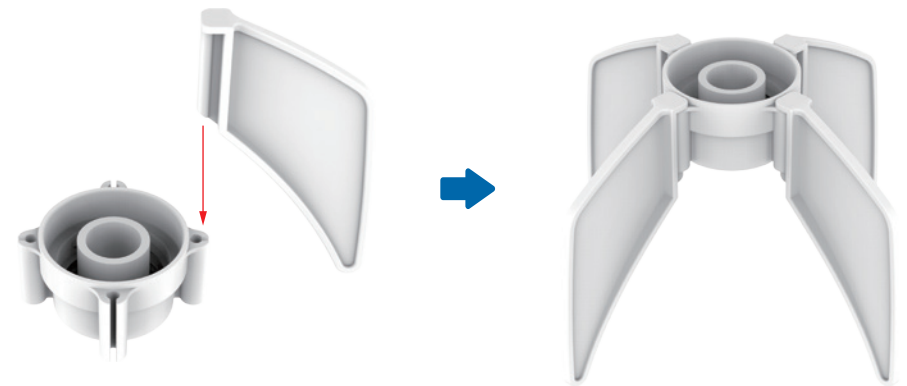
3 | INSTALLATION



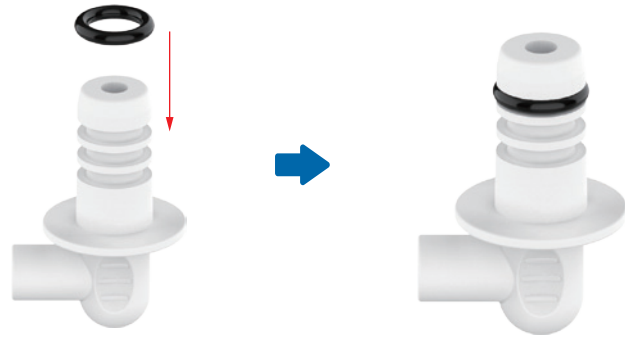
- 1 Insert the leak-proof gasket in the fin support making sure it is properly centered.



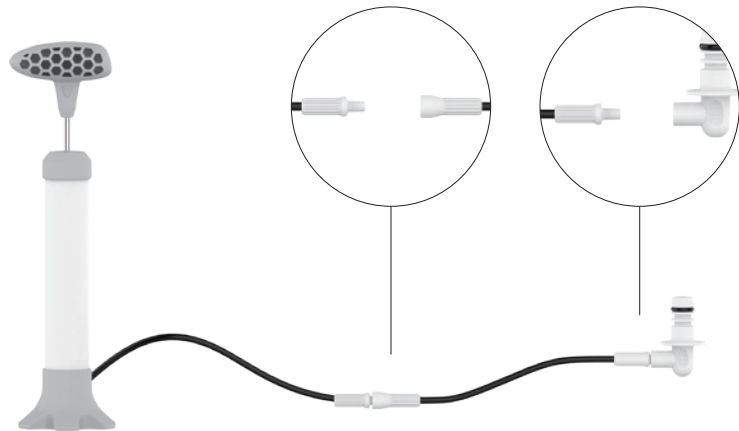
- 2 Following the diagram, assemble the empennage inserting the fins in a top-down direction.



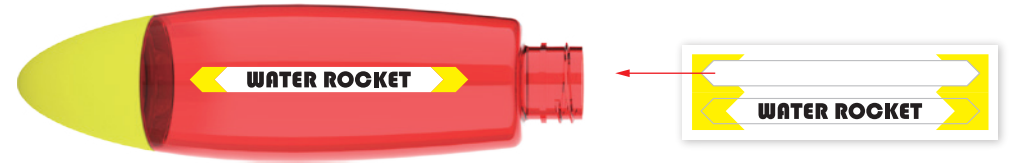
- 3 Insert an O-ring in the slots on the nozzle. The more O-rings inserted the higher the pressure can get inside the bottle, the higher the rocket will fly. (We strongly recommend you start with one O-ring. Try more under adult supervision only).



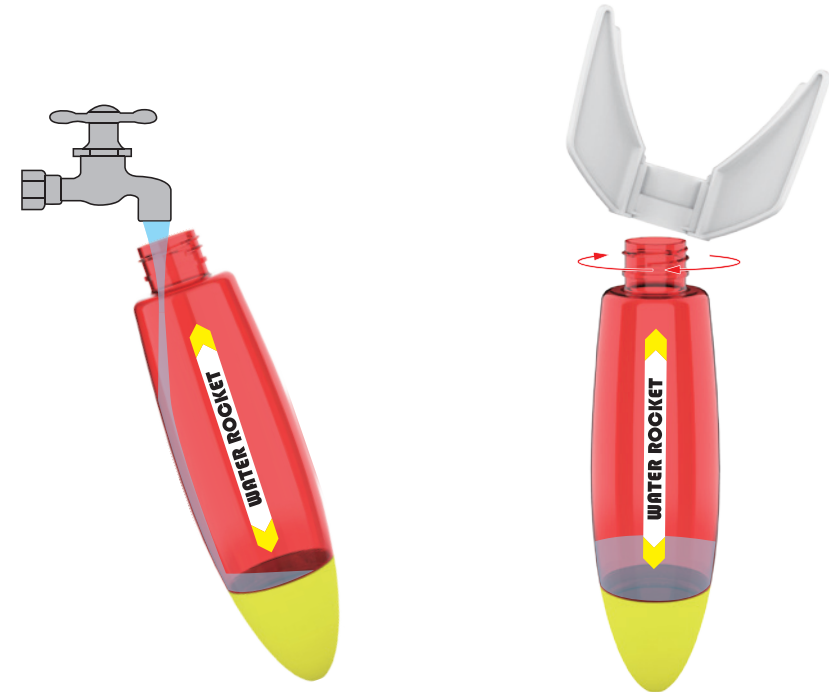
- 4 Connect the hand pump to the air tube then to the nozzle. The total length of the air tube is about 2m. (Image not to scale)

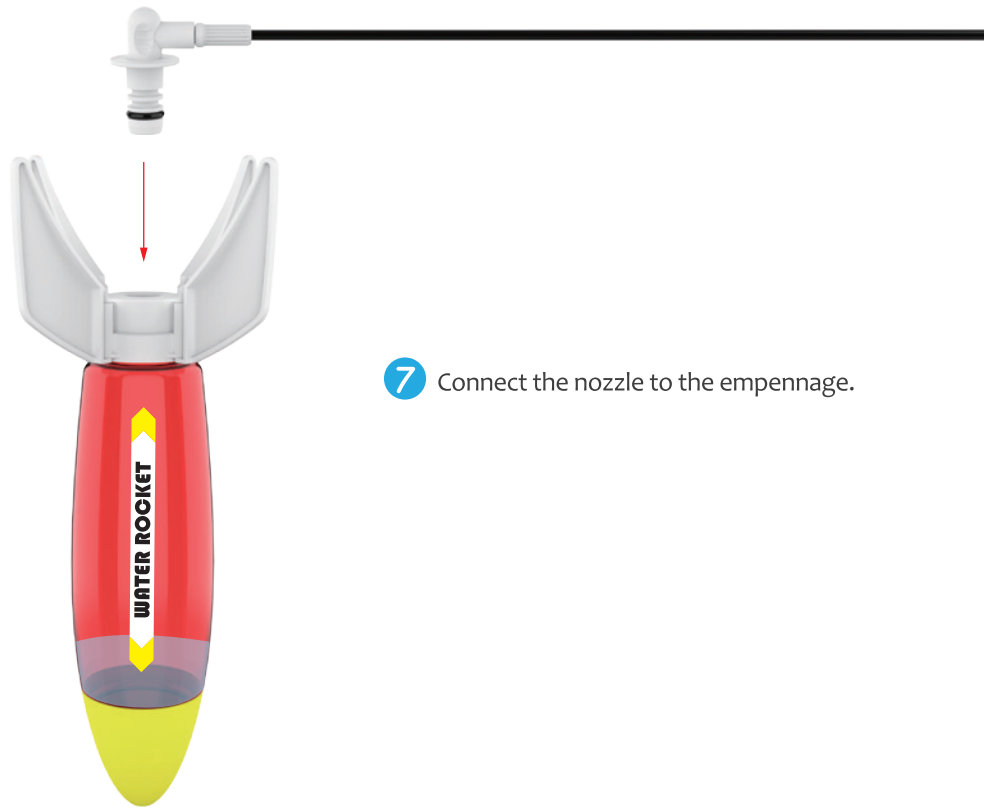


- 5 Apply the stickers.



- 6 Fill the bottle with water. We recommend to fill with only 1/4 of water for the first use. (See "How to launch the rocket" section). Screw the empennage at the back of the rocket.





7 Connect the nozzle to the empennage.

8 Place the rocket on a flat surface, it is ready for launch.

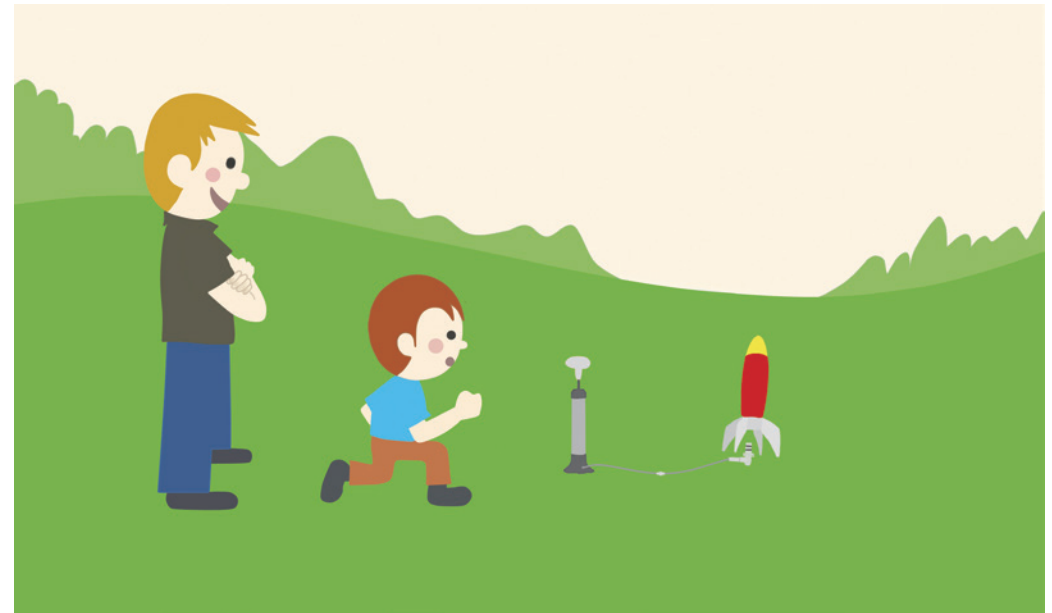


4 | ACTIVITIES



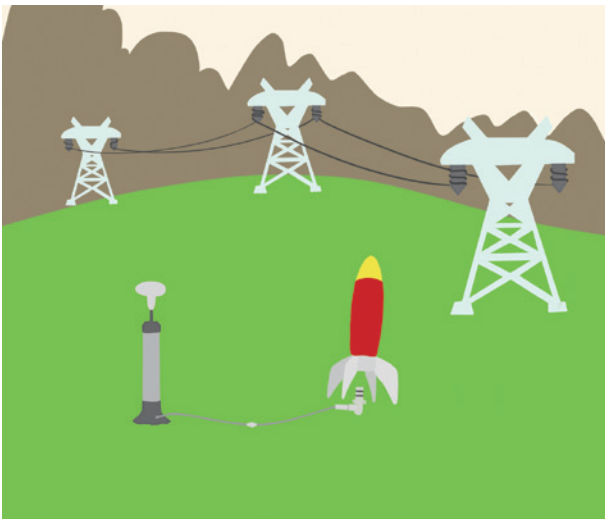
Before launching the rocket, we have a short safety briefing for you

- 1 Conduct the experiment in an open area.

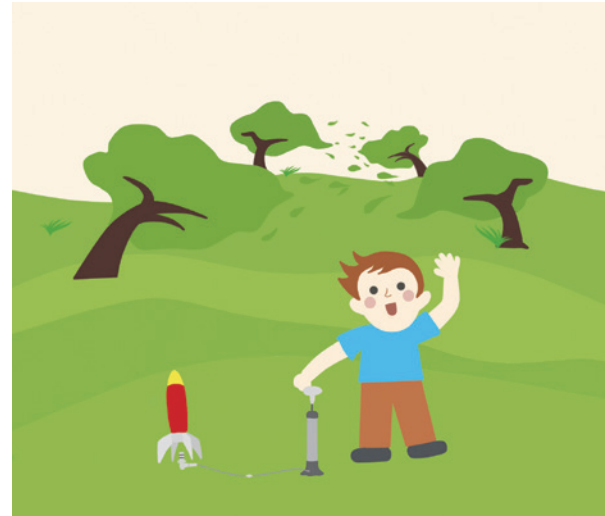




- 2 Do not point or launch towards humans or animals. Do not try to catch a falling rocket.



- 3 Do not launch under power lines or nearby power stations.



- 4 Do not launch in strong wind. The flight pattern may become unpredictable.



- 5 Do not launch near water sources. All spectators should stay away from the launch spot and avoid the rocket when it lands.

Dear Little Scientist,

Congratulations! You are now qualified to launch the Water Rocket.

As serious scientists, we will need to test the launching environment first.

How? We advise you to use a scientific approach. Let's start filling the water rocket with 1/4 of water and set only one O-ring on the nozzle to test the launching environment. After that you can try different combinations of water amount and number of O-rings to see how it affects the launching performances.

Let's start to explore the science of the Water Rocket!

Cheers,

Chief Scientist of PlaySTEAM

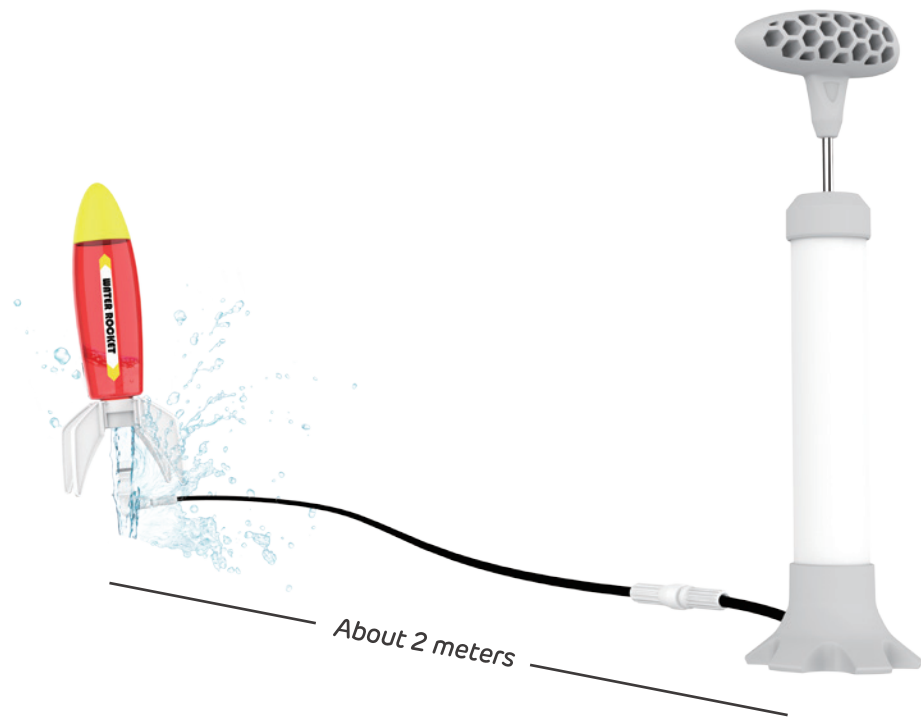


Pump and Launch

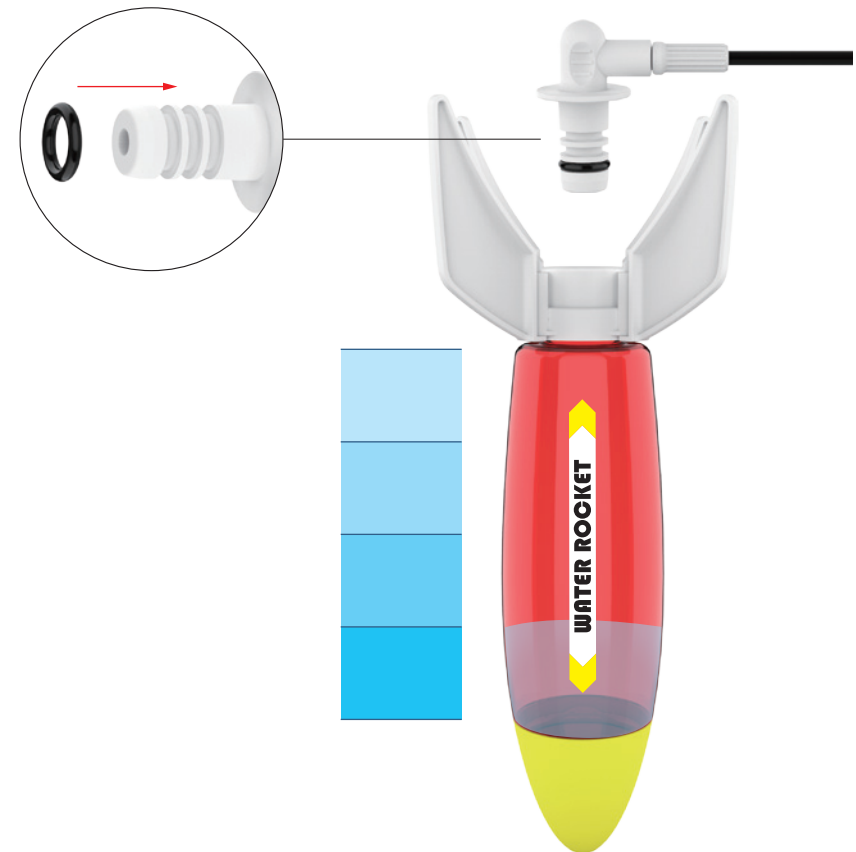
- 1 Insert the nozzle at the back of the rocket, paying attention not to pour out water.



- 2 Place the rocket on a flat surface, and start pumping from a safe distance. When the pressure inside the rocket reaches its maximum, the nozzle will automatically pop out and the rocket will fly away.



- 3 When using for the first time, it is recommended to fill the rocket with 1/4 of water and set one O-ring on the nozzle to test whether the launch site is suitable.
- 4 When the rocket launch, it will fly in a spectacular spray of water. This is all due to what we call Newton's law, check this on the next page.



How Does It Work?

First, we need to understand a new term: Newton's Third Law. This talks about a very important concept: Action and Reaction.

For every action, there is always an equal and opposite reaction.

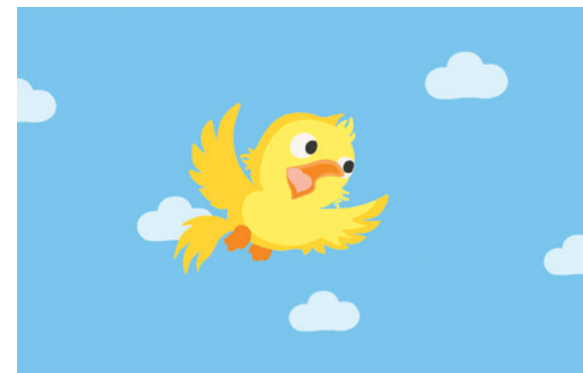
So, what does that mean?



Isaac Newton, 1643 - 1727



When you row a boat, you pull the paddle. The harder you pull the paddle, the faster the boat will go. The force you use to row a boat represents ACTION, while the boat's movement represents REACTION.



Let's have another example of Action and Reaction.

A bird flutters its wings to fly in the sky. The harder and faster the bird flutters its wings, the higher and faster it can fly. The force of these flutters represents Action Force, while the force needed to support the bird as it flies represents Reaction Force.

Easy enough to understand?

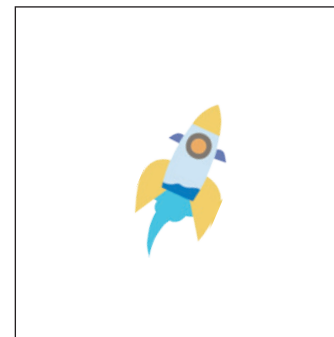
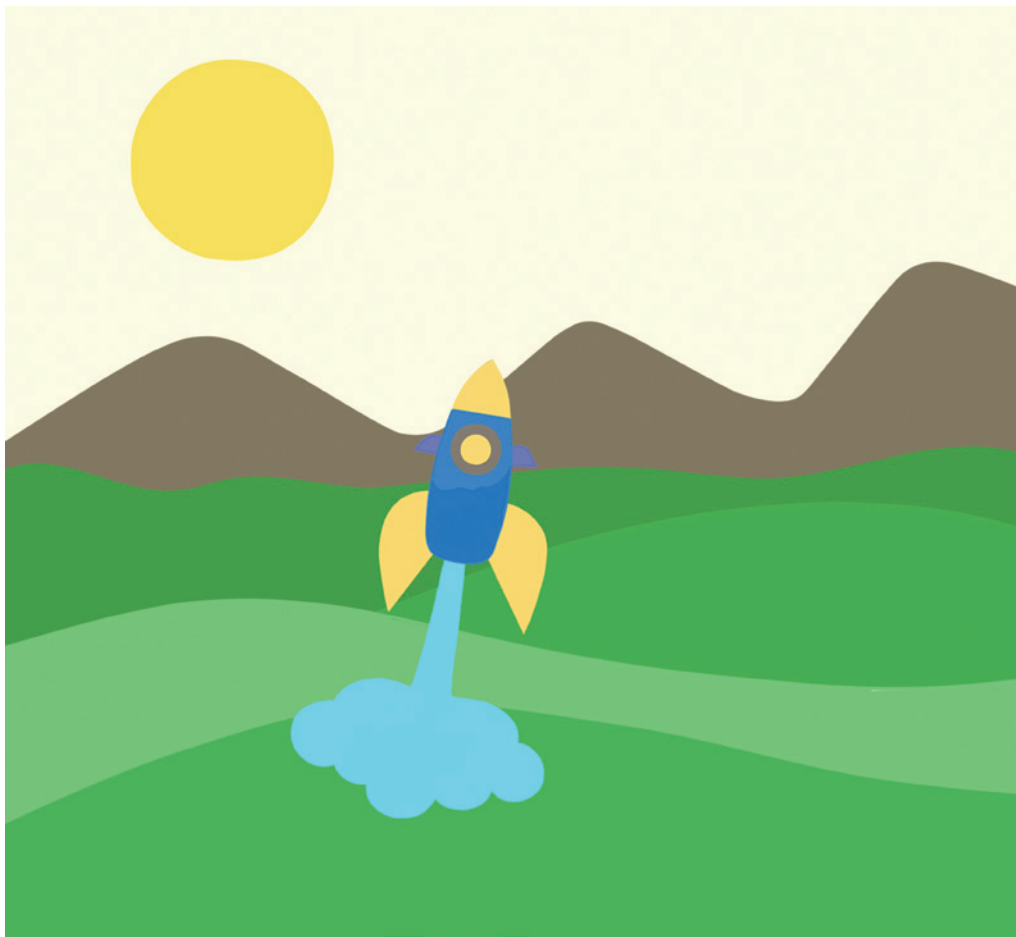


How Does This Relate to the Water Rocket?

Here, Air is the fuel for the Rocket, and it acts as an Action force that pulls the water down inside of the bottle. At the same time, the force of ejecting water creates a Reaction force that pushes the rocket upwards. Let's think about this. What if we increase the number of O-rings on the nozzle?

More O-rings on the nozzle will hold the rocket more firmly, and the pressure inside the bottle will get higher before it releases. Higher air pressure makes the water eject faster from the bottle and creates a higher Action force. As a result, it provides the same high level of Reaction force that pushes the rocket upwards. The Rocket then flies faster and higher.

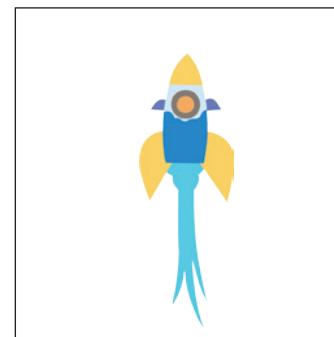
What if we increase the amount of water? Will it make the Rocket fly faster and higher?
The answer is Yes or No. Because...



Try first to fill the bottle with 10% of water, this represents $\frac{1}{10}$ of the bottle's capacity filled with water and the other $\frac{9}{10}$ with air.

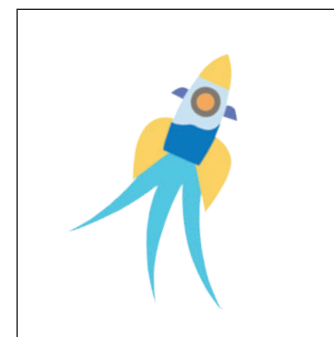
To reach the maximum air pressure in this large space and release the rocket, we need to pump a lot of air inside. Once released, you may find that the water quickly runs out from the bottle and that the rocket will fall from the sky very soon.

It is because there is not enough water, which is used here for the Reaction Force. In other words, the Reaction Force is too small to keep the rocket flying.



Let's fill the bottle with 90% water, in other words $\frac{9}{10}$ of the bottle's capacity. This means that $\frac{1}{10}$ of the bottle is empty space.

In order to reach the maximum air pressure in such a little space and release the rocket, we need to pump less air inside. Once released the rocket won't be able to fly very high because it is very heavy and the air pressure inside this little space will decrease very quickly.



What if we fill it with $\frac{1}{2}$ water?

Let's be serious rocket scientists! Record your experiment results, and figure out what is the best combination of water amount and number of O-rings.

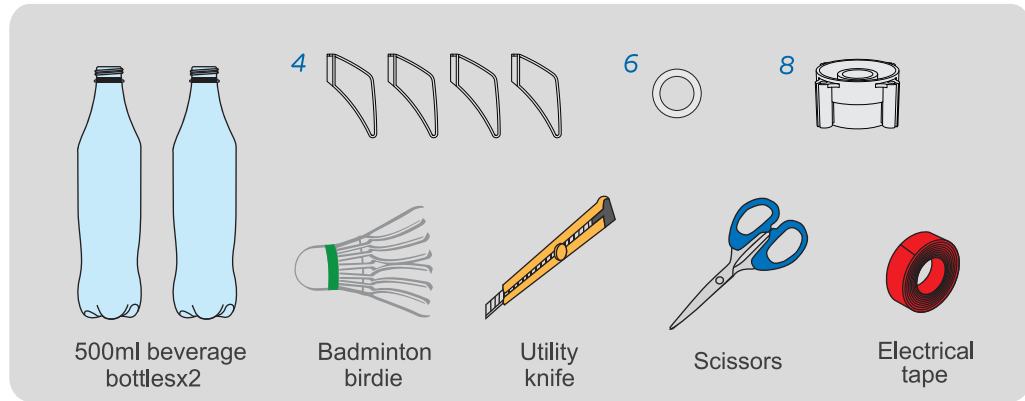
- Modern space rockets rely on liquid hydrogen and liquid oxygen for fuel.



- Space rockets only take 3 minutes to reach outer space.

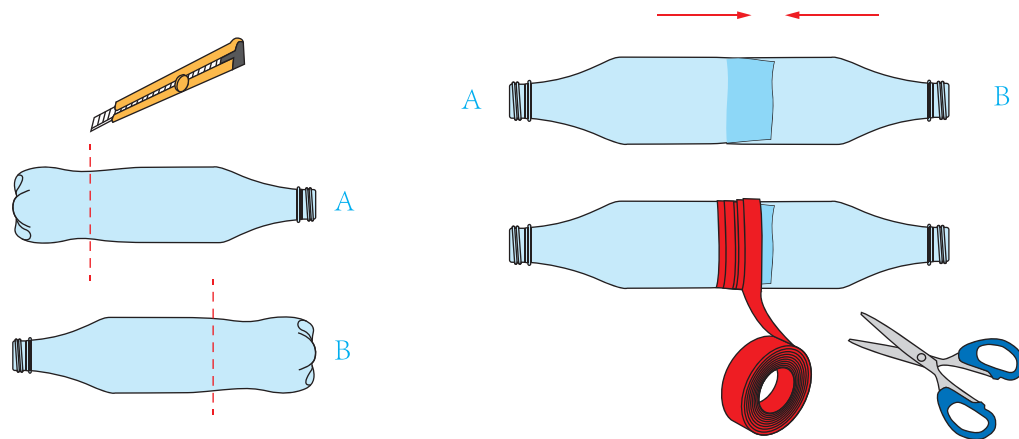


Homemade Rockets

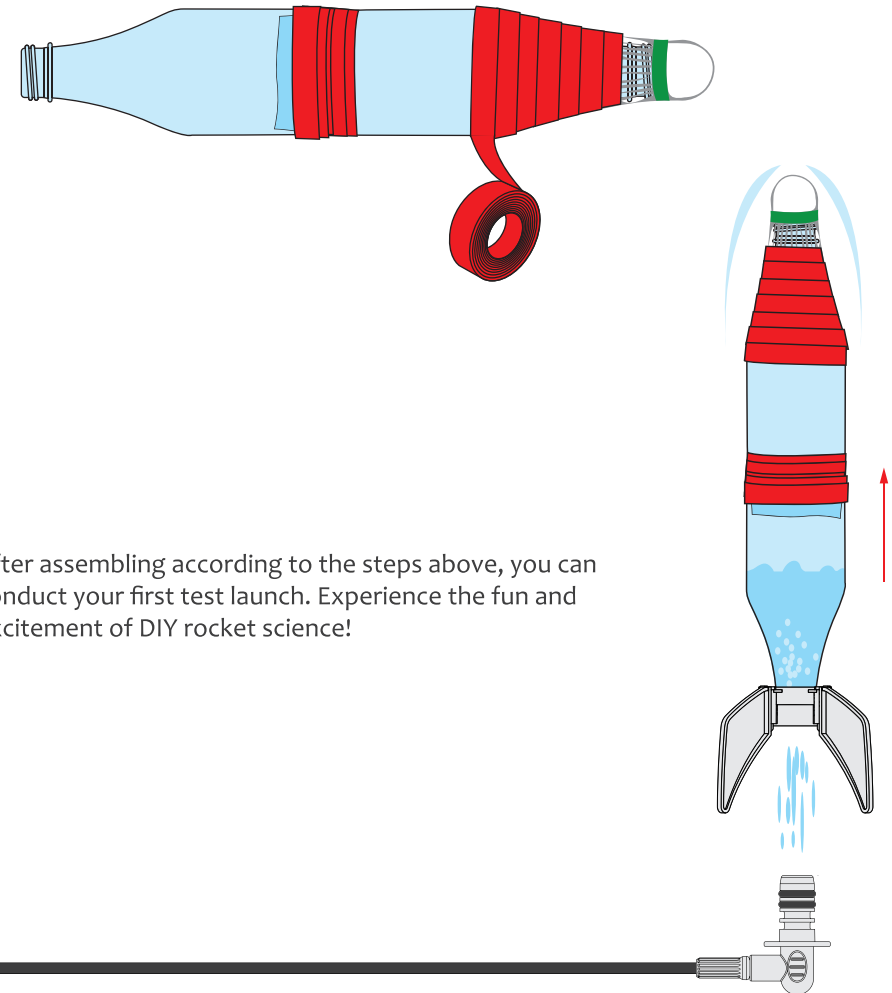


Please prepare the materials above

- 1 Use the utility knife to cut open the bottles and trim them to an even length, as shown in the diagram. Insert the body of one bottle into the other. Use electrical tape to secure the bottles together.



- 2 As the diagram shows, place the badminton birdie on top of one bottle neck and wrap it tightly with electrical tape.



- 3 After assembling according to the steps above, you can conduct your first test launch. Experience the fun and excitement of DIY rocket science!