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PLAY • READ • INSPIRE



# THE LEARNING BOOKLET

— FOR THE WATER POWERED ROCKET —

*Read to be inspired!*



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

AGES **8+**



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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 8 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**

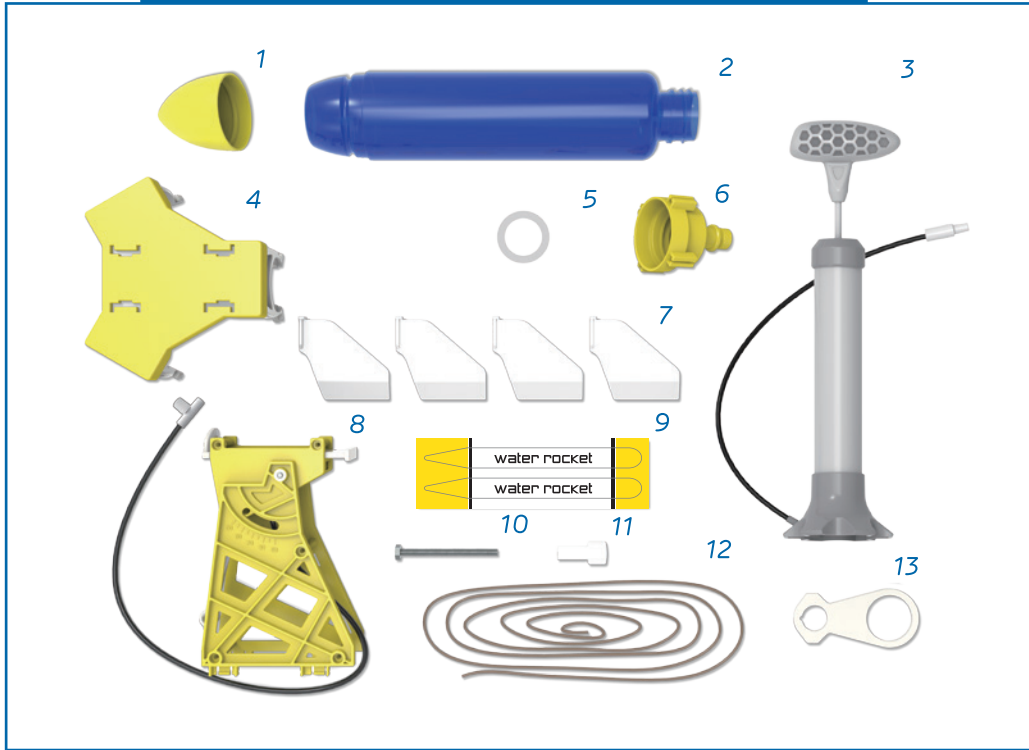




# 2 | PACKAGE CONTENTS

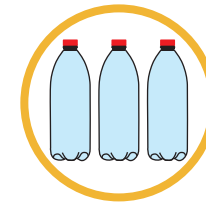


## Package Contents



Serial	Name	Quantity	Serial	Name	Quantity
1	Fairing	1	8	Launch platform	1
2	Rocket body	1	9	Stickers	1
3	Pump	1	10	M4*50 Bolt	1
4	Base	1	11	Bolt	1
5	Leak-proof gasket	1	12	Trigger string	1
6	Nozzle	1	13	Handle	1
7	Empennage	4			

## Necessary but not included

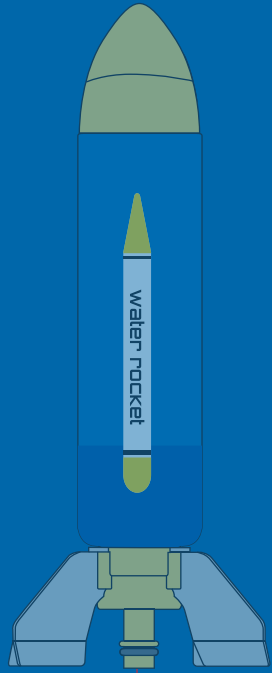


1.25/2L PET Bottle x3

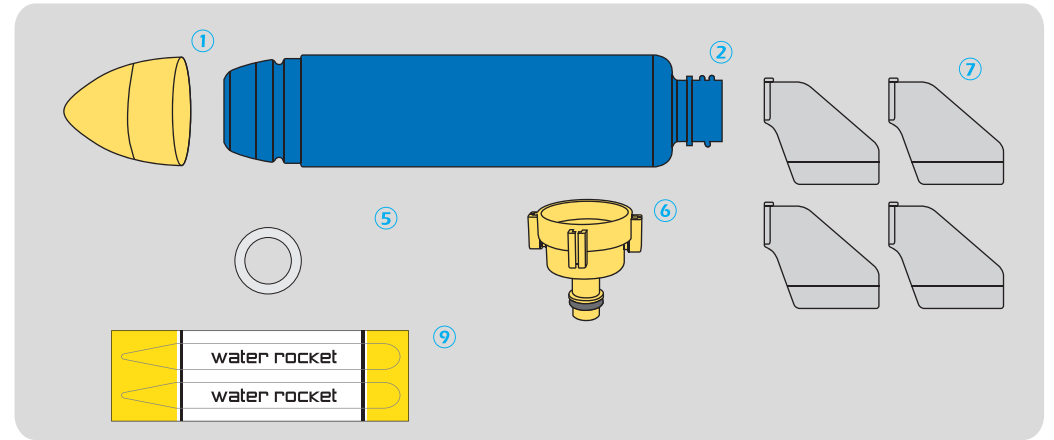


Water

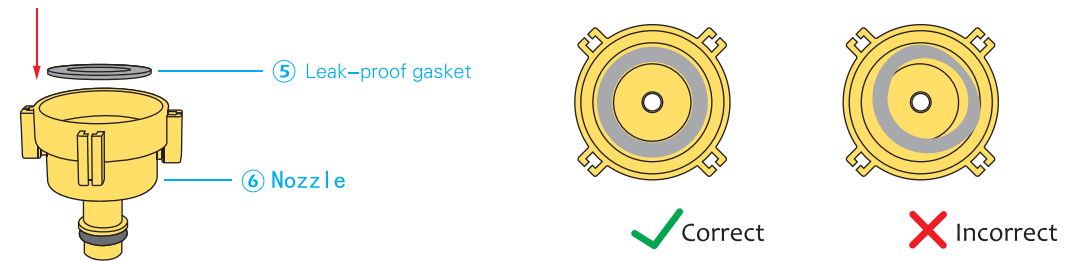
# 3 | INSTALLATION



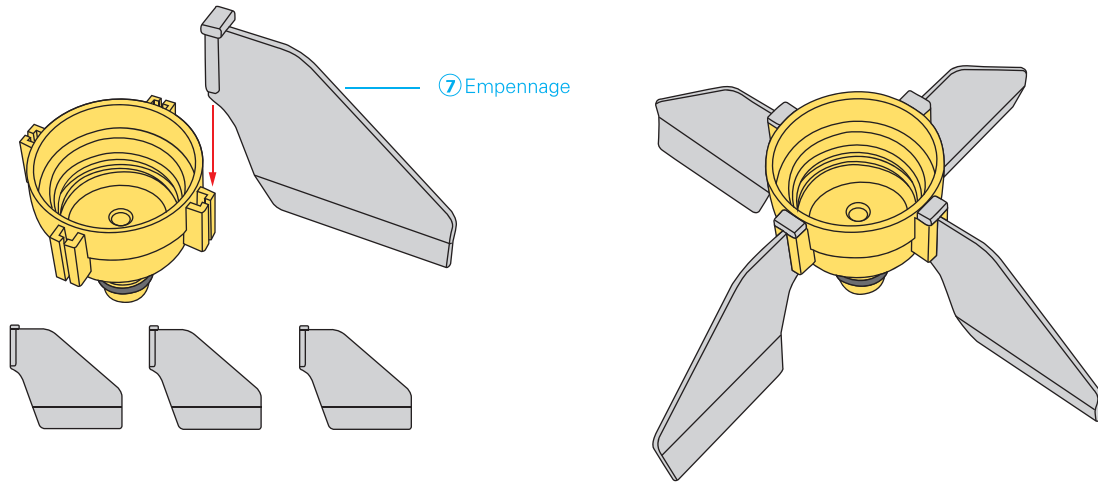
## Rocket Assembly



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



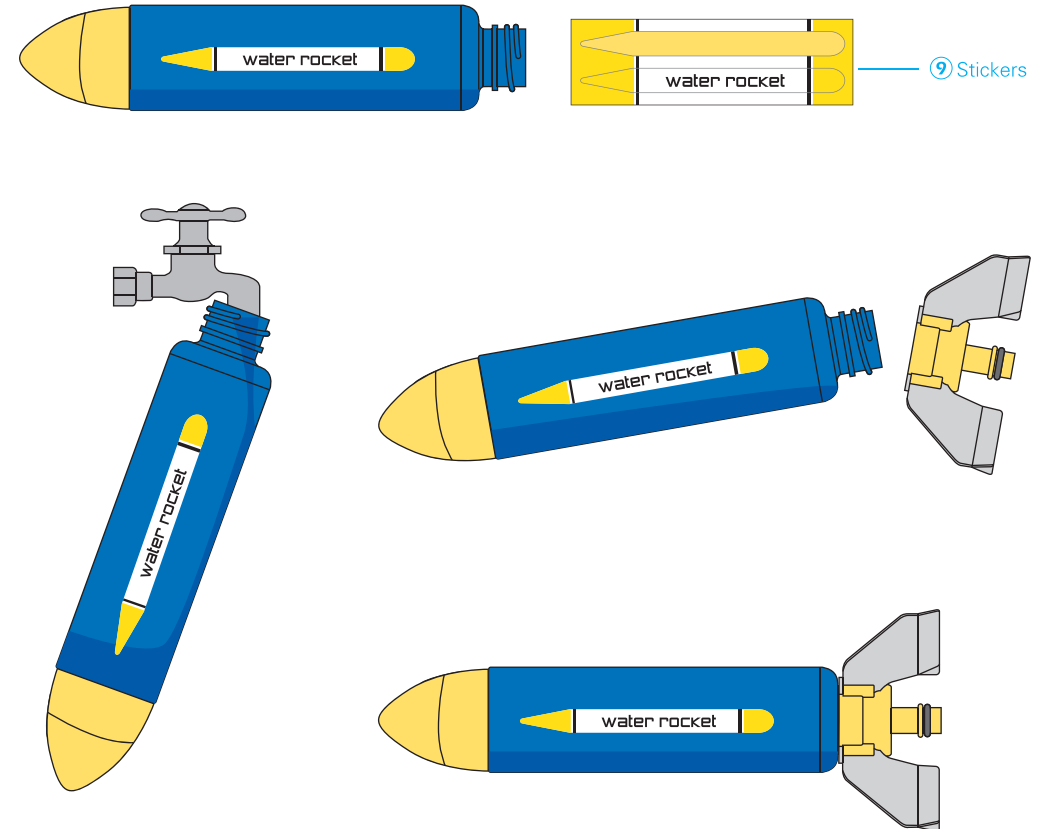
- 2 Following the order shown in the diagram, insert the empennage into the nozzle tank in a top-down direction.



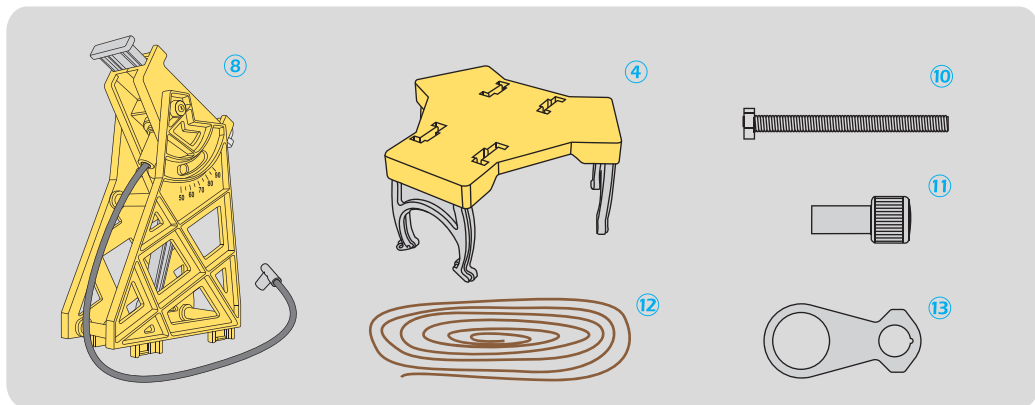
- 3 Insert the fairing connector into the slot at the rocket nose.



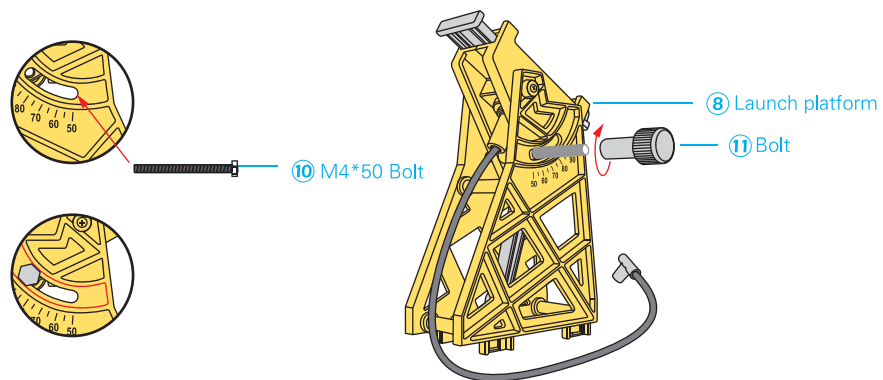
- 4 Apply the stickers to both sides of the rocket body for decoration. To adjust water levels required for launching, water can be poured into the rocket body (for the first launch, it is recommended to fill the tank only to 1/4 capacity as a test). At the same time, tightly screw the nozzle.



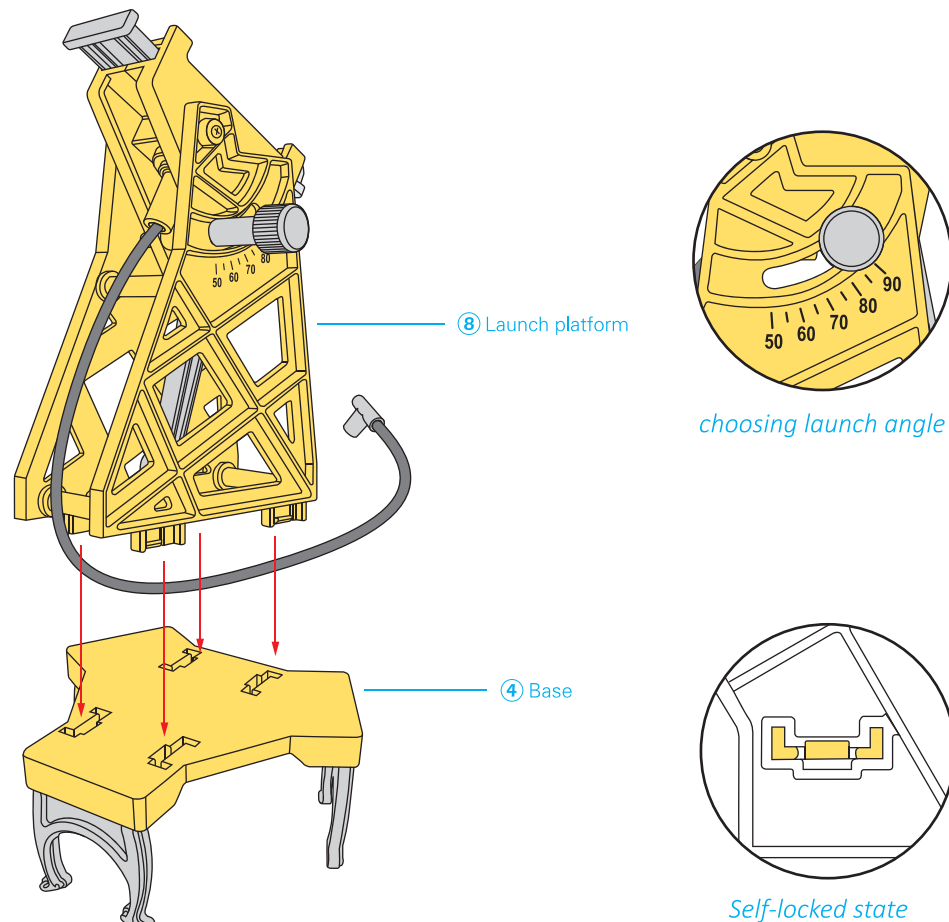
## Rocket launcher tower assembly



- 1** Insert the M4\*50 bolt through the round hole at the back of the launch platform. Ensure that the hexagonal M4\*50 bolt's head is fitted properly into the curved slot (see the red-bordered diagram). Tighten bolt in a clockwise direction from the front.

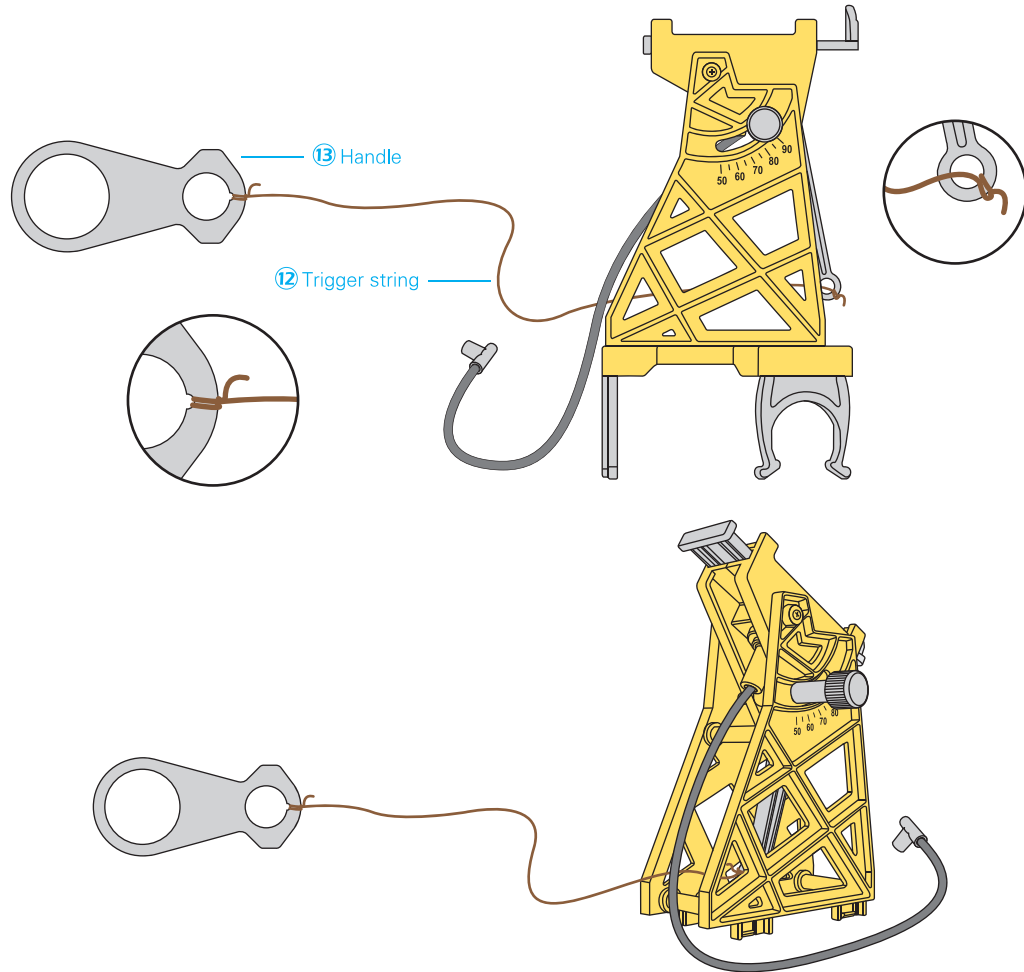


- 2** As shown in the diagram, fasten the launch platform to the base at the desired launching angle. Ensure that the four corners of the base are in a self-locked state.

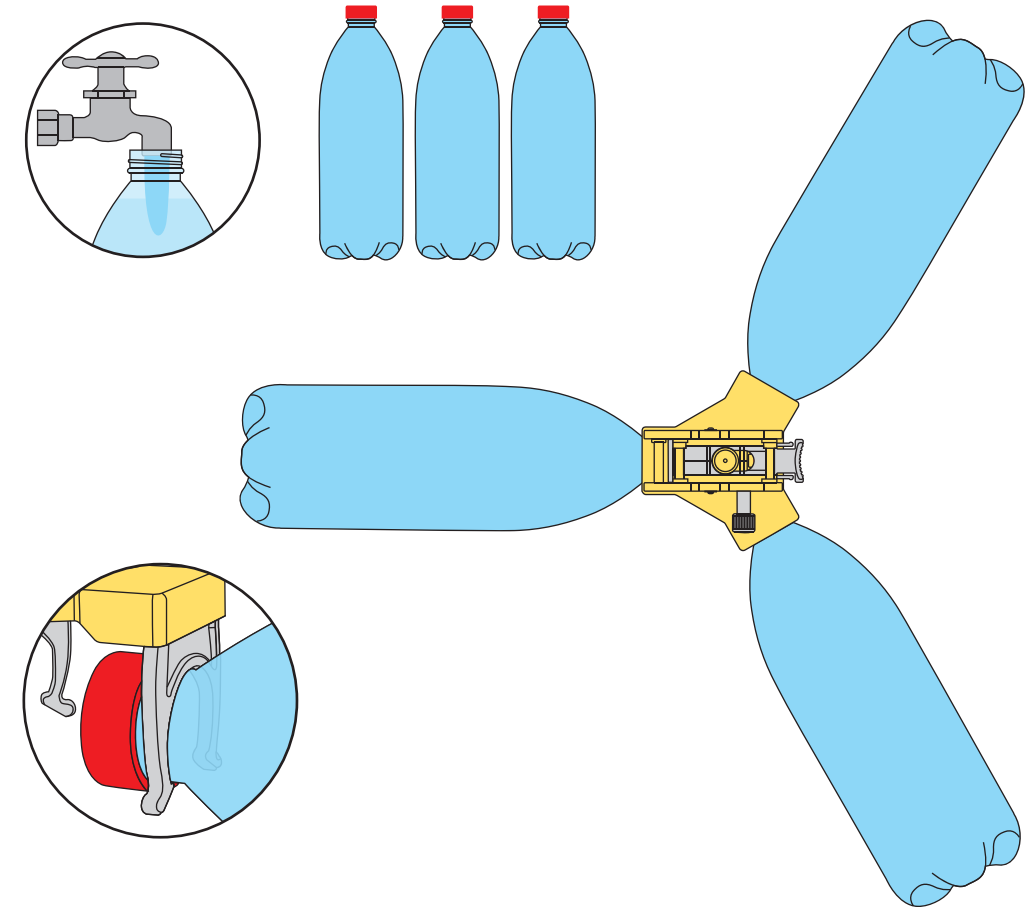




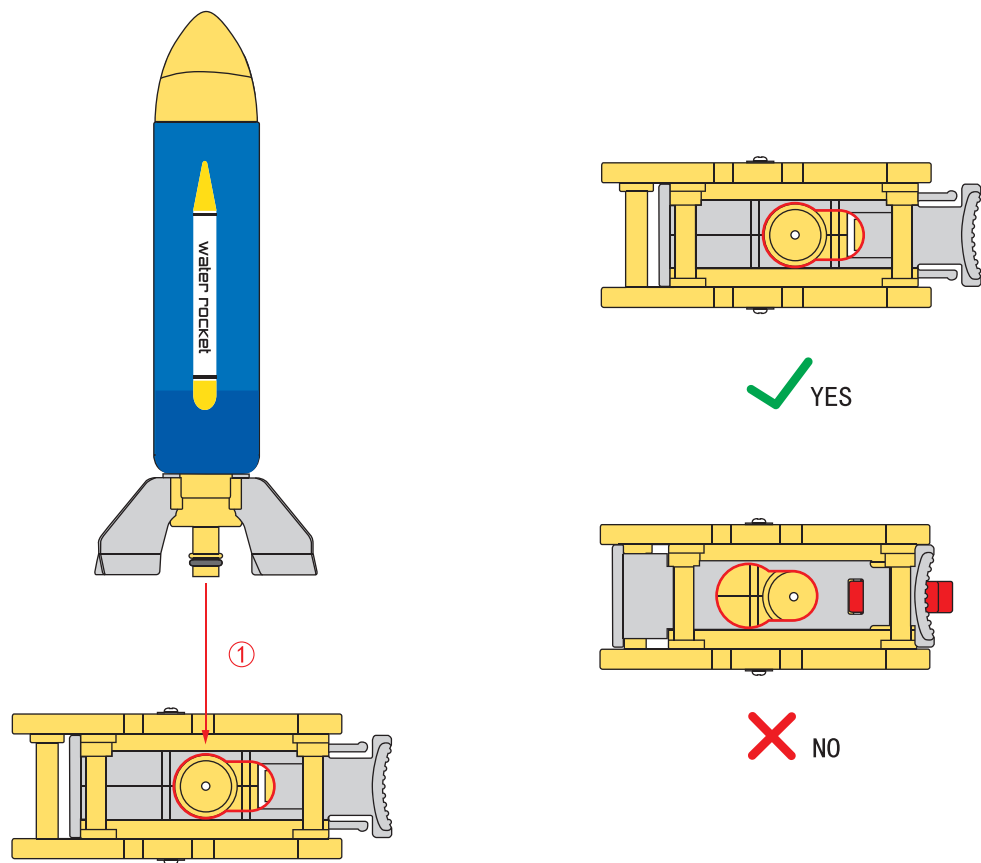
- 3 Fasten the trigger string to the holes in the launch platform trigger and handle. Ensure that the trigger string is threaded through the center of the launch platform.



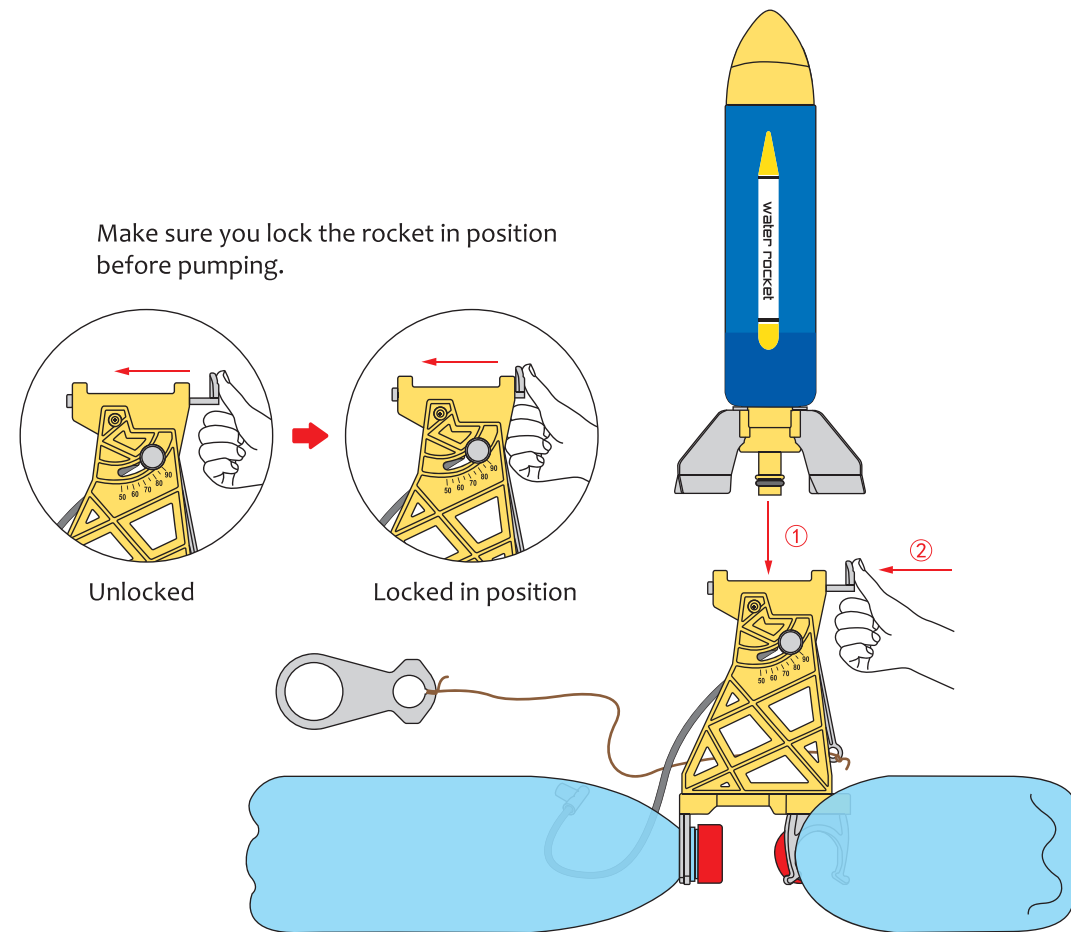
- 4 Take three empty bottles (at least 1.25 liters in size), fill them with water, and fasten them to the bottle base. (Note that you can choose to use 2-liter bottles to create a heavier, more secure launch platform)



- 5 Insert the rocket into the launch platform paying attention to the position of the circular hole in the center of the slide. (see red-bordered diagram).



- 6 Hold the rocket tightly down to the launch platform and lock the rocket by pushing the slide.

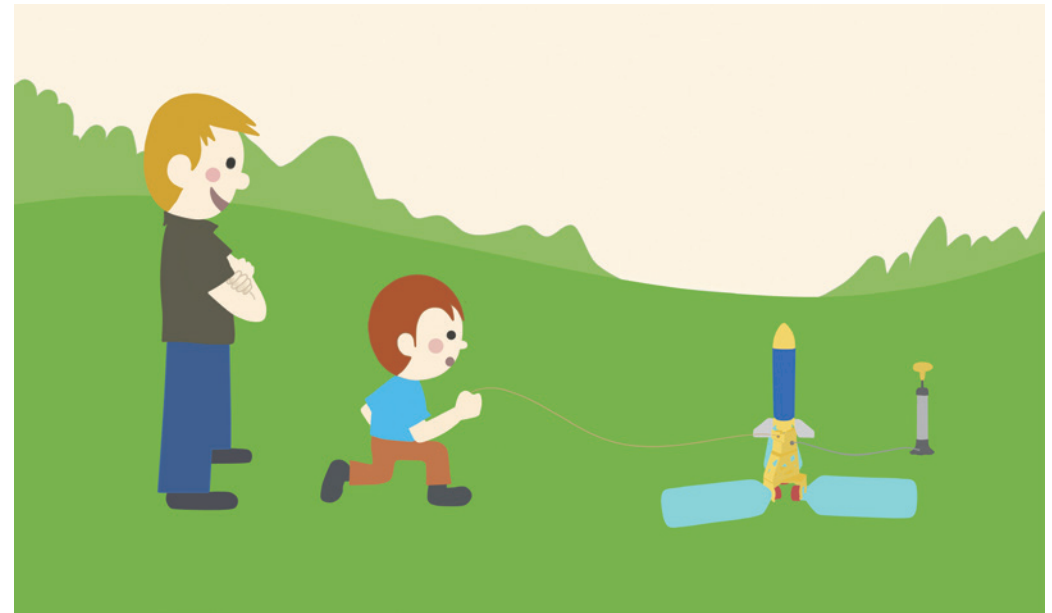


# 4 | ACTIVITIES



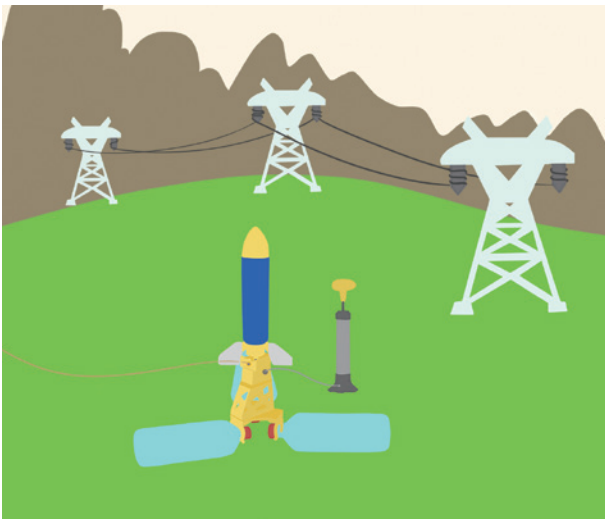
Before launching the rocket, we have a short safety briefing for you

- 1 Conduct the experiment in an open area.

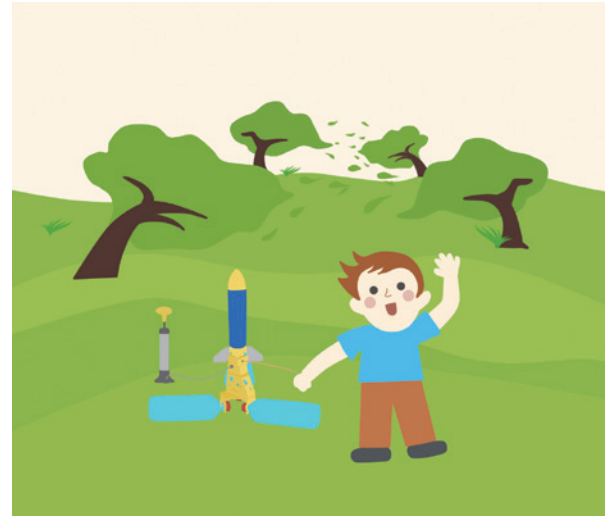




2 Do not point or launch towards humans or animals.



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.

## 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 that you use the scientific approach. Let's start with 10 pumps and fill it with 1/4 water to test the launching environment. After that, you can try different combinations of pumps and water amounts to see variations of angles and distances.

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

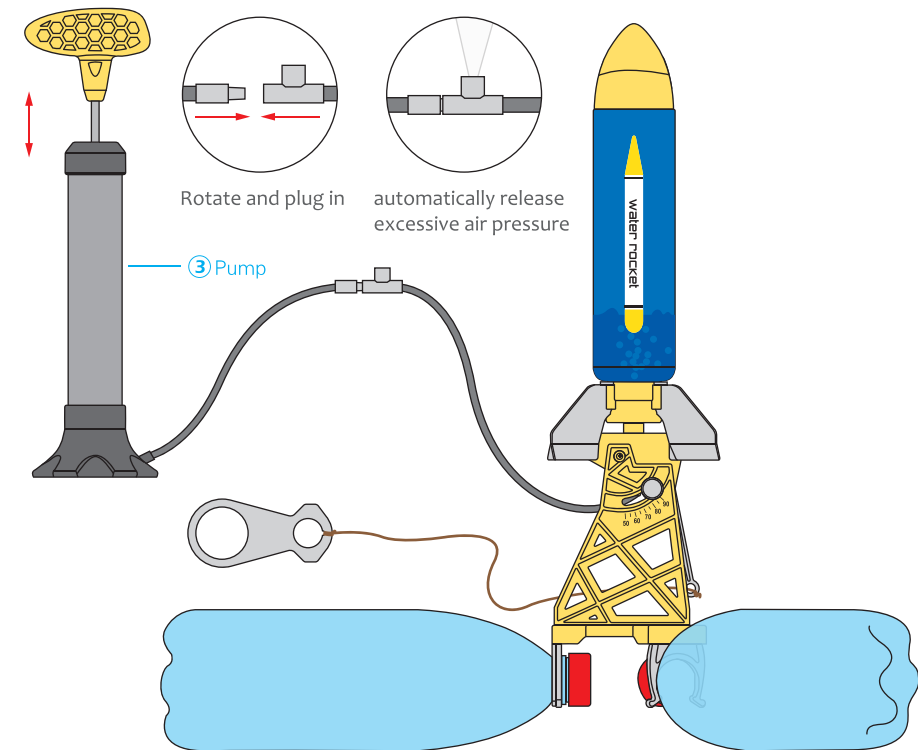
Cheers,

Chief Scientist of PlaySTEAM

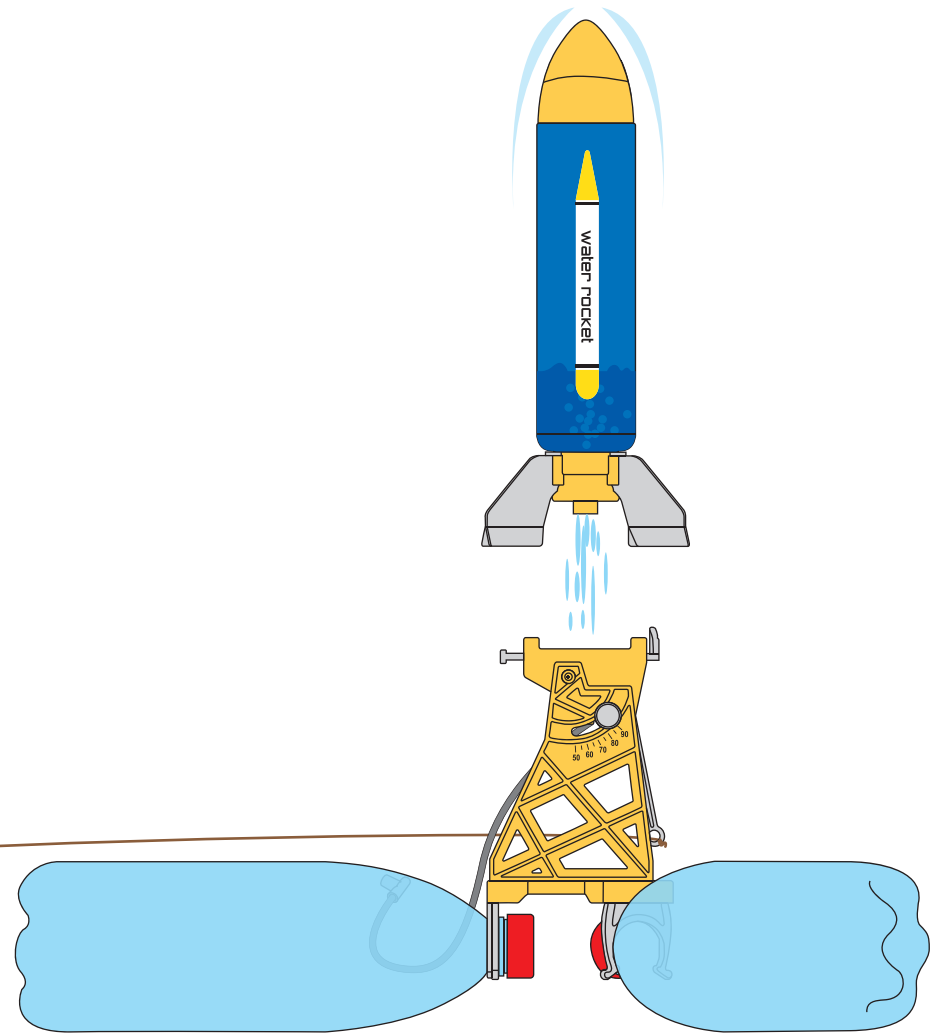
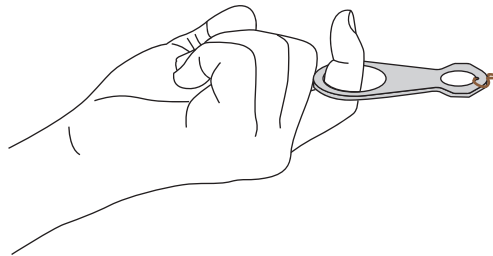


## Pump and Launch

- 1 Fasten the inflation tube according to the diagram. Pump the handle up and down to increase the air pressure inside the rocket body. The inflation tube connector has a specially-designed safety valve to release excess pressure. When air pressure inside the rocket body reaches its maximum level, the inflation tube will automatically release air through the valve.



- 2 When using for the first time, it is recommended to pump the inflator no more than 10 times to test whether the launch site is suitable.
- 3 From a safe distance, pull the trigger string, and the rocket will launch in a spectacular spray of water.



## 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.

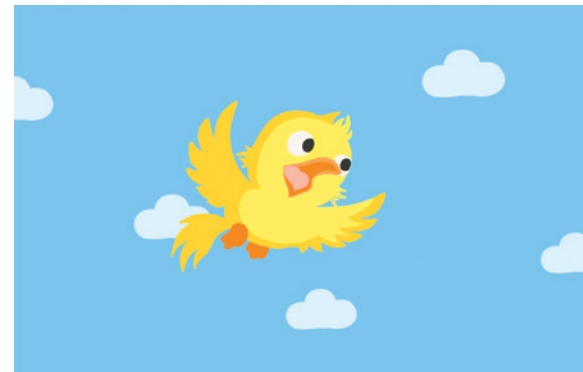
So, what does that mean?



Isaac Newton, 1643 - 1727



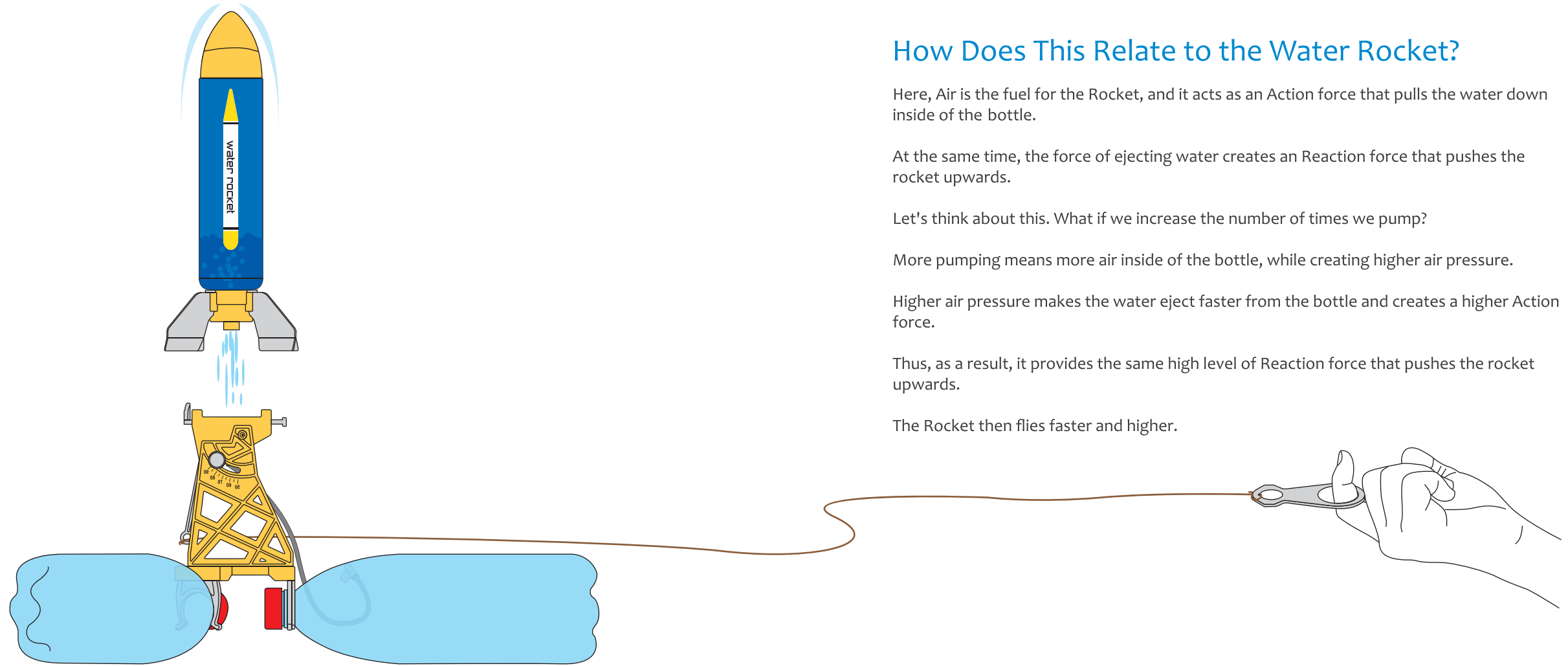
When you row a boat, you pull the paddle. The harder you pull the paddle, the faster the boat will go. The force you use to row a boat represents ACTION, while the boat's movement represents REACTION.



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 an Reaction force that pushes the rocket upwards.

Let's think about this. What if we increase the number of times we pump?

More pumping means more air inside of the bottle, while creating higher air pressure.

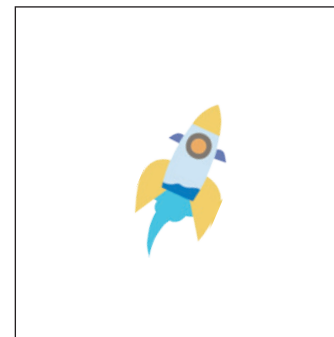
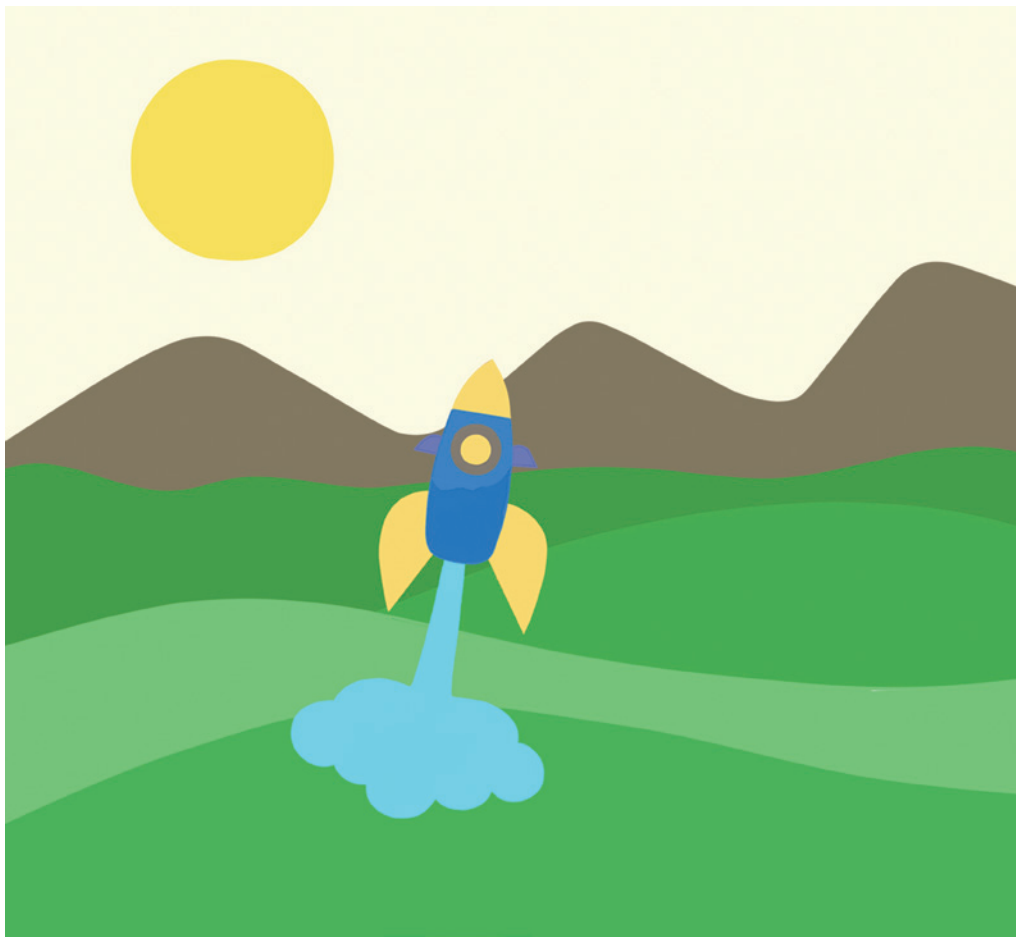
Higher air pressure makes the water eject faster from the bottle and creates a higher Action force.

Thus, as a result, it provides the same high level of Reaction force that pushes the rocket upwards.

The Rocket then flies faster and higher.



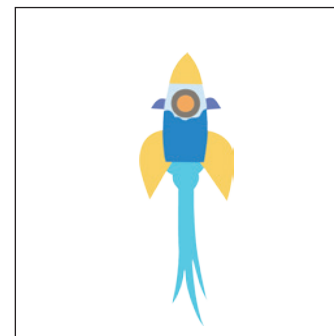
What if we increase the amount of water? Will it make the Rocket fly faster and higher?  
The answer is Yes or No. Because...



When we fill the bottle with 10% water, this represents  $\frac{1}{10}$  of the water inside of the bottle.

You may find that the water quickly runs out from the bottle and that the rocket will fall from the sky very soon.

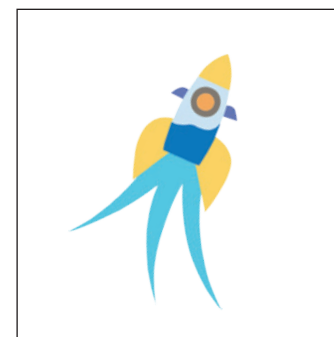
It is because there is not enough water, which is used here for the Reaction Force. In other words, the Reaction Force is too small to keep the rocket flying.



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

If we need to provide sufficient Action Force to launch the rocket, we need to pump 10 times the air into such a small space.

You will find it very difficult to pump, right?

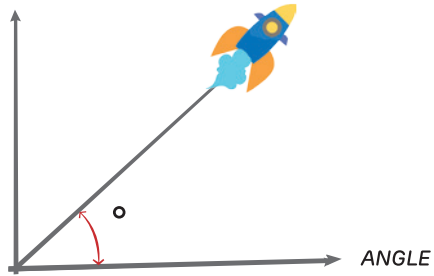


What if we fill it with  $\frac{1}{2}$  water?  
Let's be serious rocket scientists! Record your experiment results, and figure out the best water and pump balance.

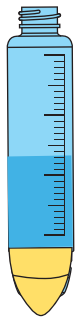
Amount of Pumping



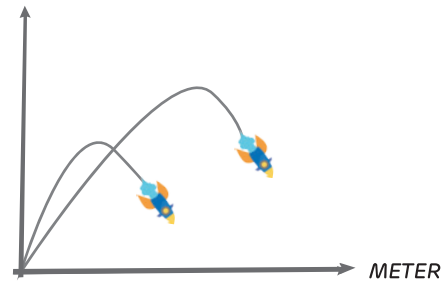
Launching Angle



Amount of Water



Launching Distance



Water Rocket Launching Experiment Record Sheet

Launch No.	Angle	Amt of Pumping	Amt of Water	Distance (meters/ feet)

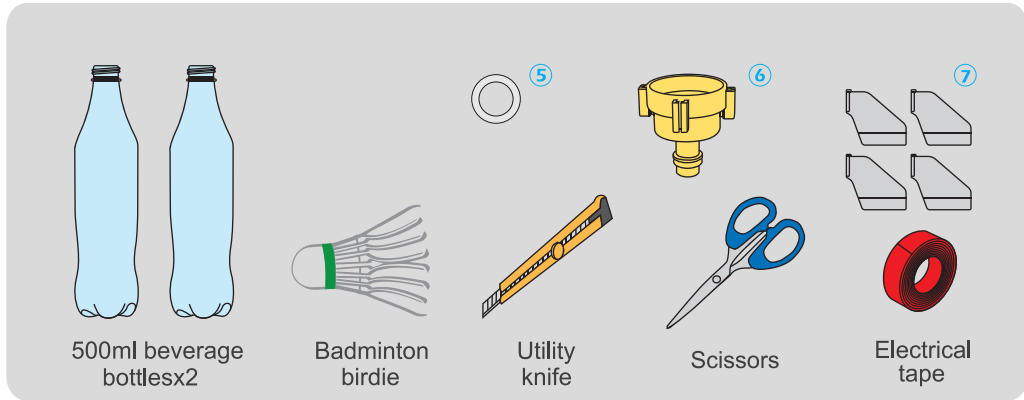
- Modern space rockets rely on liquid hydrogen and liquid oxygen for fuel.



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

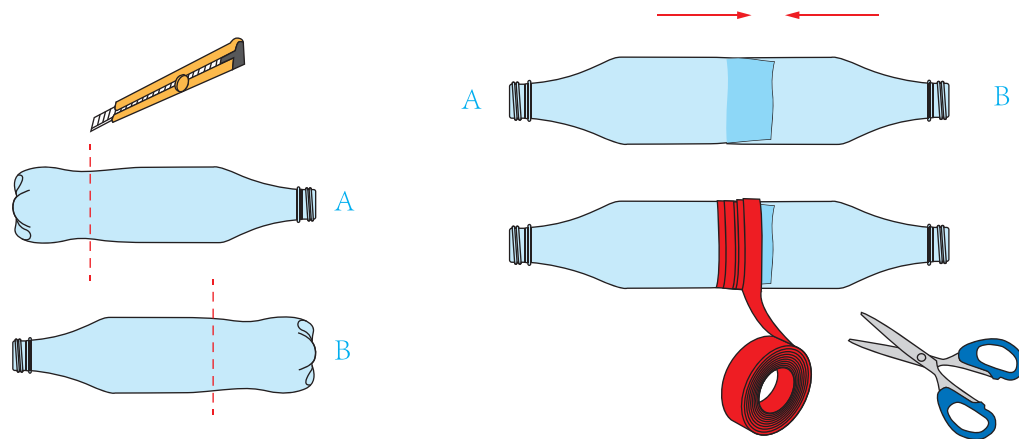


## Homemade Rockets

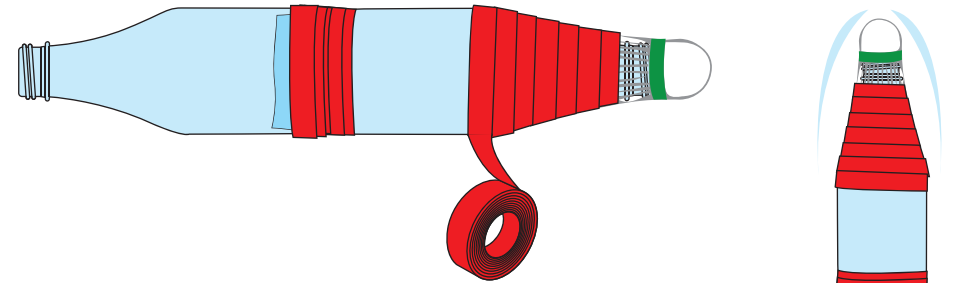


Please prepare the materials above

- 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!

