WONDERY KIDS

THE ULTIMATE HIGH-FLYING AIR ROCKET

WOW-TO GUIDE

WOW IN THE WORLD

THAMES & KOSMOS

SAFETY INFORMATION

⚠ WARNING:

CHOKING HAZARD — Small parts. Not for children under 3 yrs.

WARNING: Read all warnings and instructions before use, follow them, and keep them for reference.
Warning! To reduce the risk of serious eye injury or blindness: Do not launch the rocket at yourself or others. Keep bystanders behind the launch pad. Do not catch rockets.
Warning! To prevent serious eye or face injuries:
1) Read all warnings and instructions before use, follow them, and keep them for reference.
2) Do not aim at eyes or face.
3) Do not aim at people or animals.
4) Stay out of the path of, and do not attempt to catch, falling rockets.
5) Make sure the launch area and flight path are clear before launching.
6) Never climb trees, structures, or other things to retrieve rockets.
7) Do not modify the product from its original design.
8) Discard broken components immediately.
9) Do not discharge an object other than the projectile provided with this toy.
10) Use of eye protection (not included) is recommended for users and people within range.
WARNING! Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.
Strangulation hazard — long hose and tape measure may become wrapped around the neck.
Keep the packaging and instructions as they contain important information.

Have any questions? Missing any parts? Want to send us a compliment? Our tech support team will be glad to help you!

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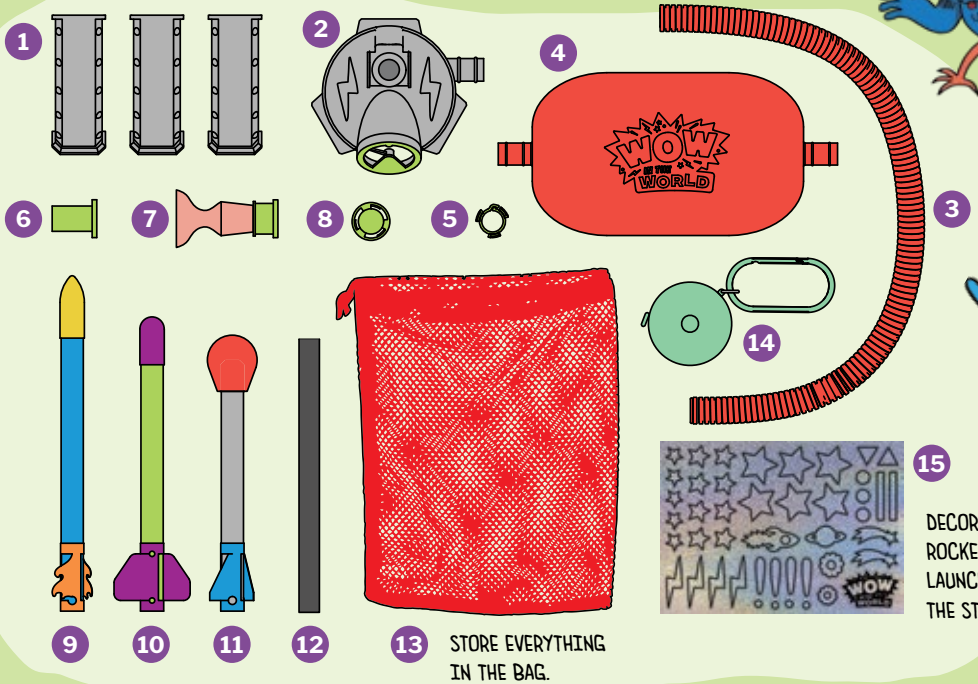
KIT CONTENTS



Part No.	Description	Quantity
1	Launch pad leg	3
2	Launch pad hub	1
3	Air hose	1
4	Stomp pad	1
5	Nozzle adapter ring	1
6	Whistle nozzle	1
7	Fart nozzle	1
8	Nozzle cap	1

Part No.	Description	Quantity
9	Long rocket	1
10	Medium rocket	1
11	Short rocket	1
12	Launch tube	1
13	Mesh storage bag	1
14	Tape measure with clip	1
15	Sticker sheet	1

INTRODUCTION

MINDY THOMAS
(*WOW IN THE WORLD* HOST)

WELCOME TO YOUR AIR ROCKET WOW-TO GUIDE!

GUY RAZ
(*WOW IN THE WORLD* HOST)

THIS GUIDE HAS ALL THE INFO YOU NEED FOR ASSEMBLING, LAUNCHING, AND EXPERIMENTING WITH YOUR ROCKETS!

AND DON'T FORGET TO USE THE QR CODE BELOW TO HEAR SOME OUT-OF-THIS-WORLD SCIENCE FACTS FROM US ...

... INCLUDING HOW ROCKETS AND FARTS ARE NOT SO FAR APART!!

GET READY FOR BLAST OFF IN 3 ... 2 ... 1!

WOW IN THE WORLD

Wow in the World is the #1 kids science podcast, hosted by Guy Raz and Mindy Thomas!

Start here!

1. Grown-ups! Scan this QR code to start your **audio journey.**
2. Listen to **Track 1,** a *Wow in the World* Bonus Episode!
3. Unlock exclusive **Wow Facts** from Guy & Mindy when you see this symbol in the guide!

#1

WOW FACT

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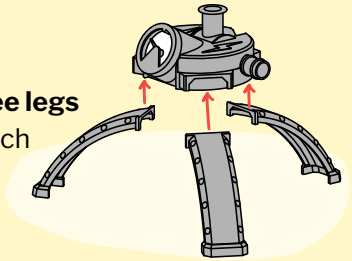
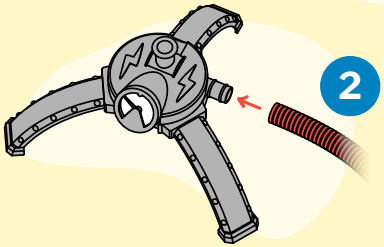
(Terms and conditions apply. See back of front cover for more details.)

LAUNCHER SETUP

1 Push all **three legs** into the launch pad hub.

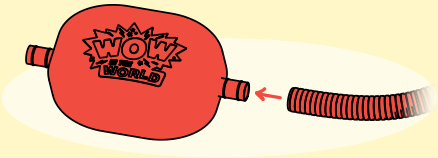




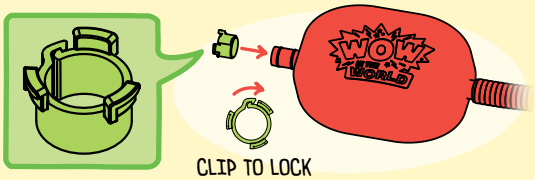
2 Slide the **air hose** all the way onto the nozzle on the **launch pad hub.**

3 Slide the other end of the air hose all the way onto one of the nozzles on the **stomp pad.**

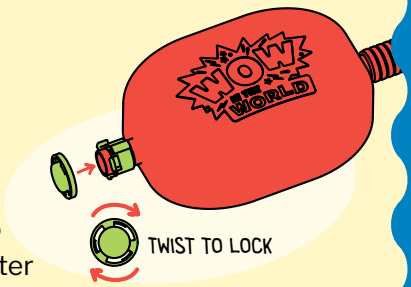
YOU MIGHT NEED TO TWIST THE HOSE A LITTLE AS YOU SLIDE IT ON.



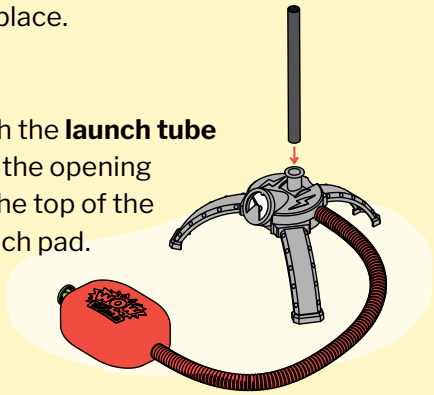
4 Clip the **nozzle adapter ring** around the other nozzle, between the two ridges.



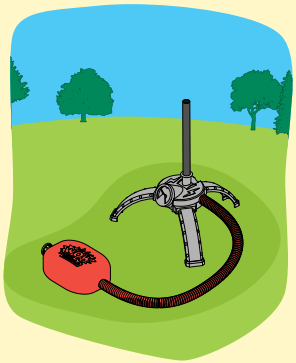
4 Connect the **nozzle cap** onto the nozzle adapter ring and **twist to lock** it in place.



5 Push the **launch tube** into the opening on the top of the launch pad.



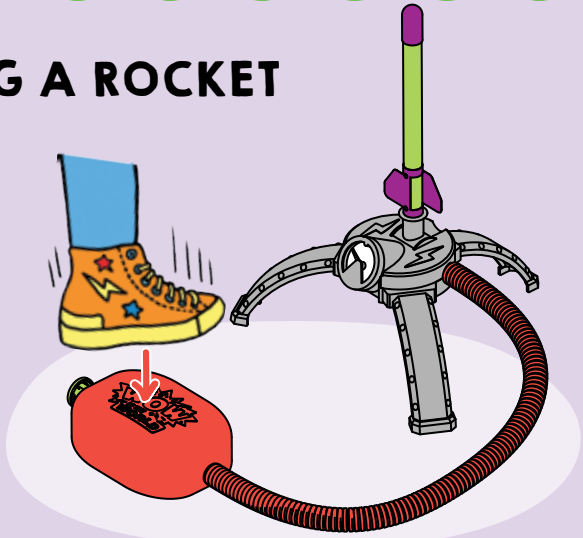
6 Place the launch pad in a **wide open area.** Do not aim it at people, animals, or anything that might break. Don't launch your rockets near trees, buildings, or streets so you don't lose or damage them.



LAUNCHING A ROCKET

1 Slide a **rocket** down onto the launch tube.

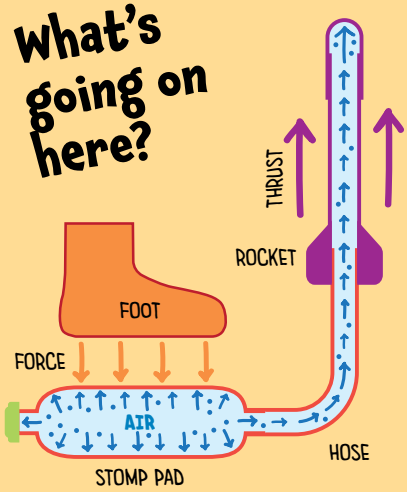
2 **Jump or stomp** on the stomp pad to launch the rocket. Also try just stepping on it lightly. What do you notice?



WOW FACT #2 "What fuels real rockets?"

WHEN YOU ARE DONE PLAYING, STORE EVERYTHING IN THE MESH STORAGE BAG.

What's going on here?



The stomp pad is filled with **AIR.** Air is made of very small particles that we cannot see. When you feel wind, you are feeling countless moving air particles pushing on your skin. This push is called a **FORCE.** The force exerted by air on a surface is called **AIR PRESSURE.**

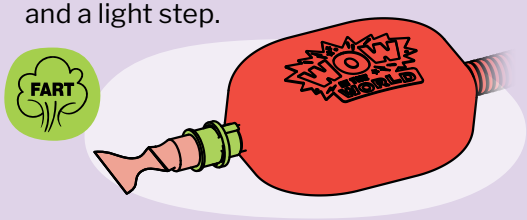
When you stomp on the stomp pad, the air particles inside it are pushed into a smaller space. They have no where else to go, so they are quickly pushed through the hose and up into the rocket. The air particles push outward on all parts of the system with lots of force — as indicated by the pressure meter.

Since the rocket is not attached to the launch tube, the air actually pushes the rocket up off the tube, propelling it high up into the air. This push is called **THRUST,** and the forward motion of the rocket is called **PROPULSION.**

EXPERIMENTS

Let 'Er Rip

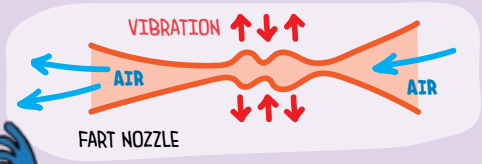
Remove the nozzle cap and attach the **fart nozzle** to the stomp pad. Now try launching a rocket with both a stomp and a light step.



What's happening?

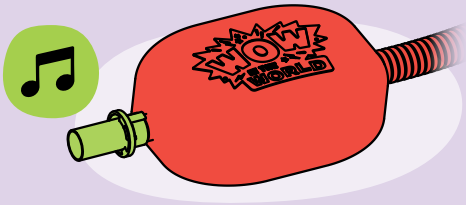
Since some of the air is going out the fart nozzle, two things are happening: First, the rubbery flaps of the fart nozzle VIBRATE and slap against each other, making the FART SOUND. And second, the rocket does not fly as high.

The slower you stomp, the louder and longer the fart, because the more air passes out of the fart nozzle where it makes the sound. Energy is going toward making the sound instead of launching the rocket.



Whistle Stomp

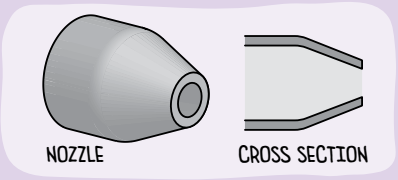
Now attach the **whistle nozzle** to the stomp pad. Try launching a rocket with both a stomp and a light step.



What's happening?

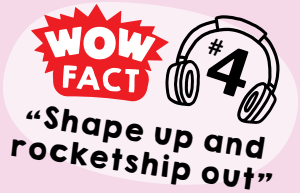
Some of the air is exiting through the whistle nozzle, which has a special shape that produces a SIREN-LIKE SOUND.

A **NOZZLE** is basically an opening at the end of a tube that changes the size of the tube, thus changing the speed of the fluid (gas or liquid) flowing through it. NOZZLES ARE ACTUALLY CRITICAL TO HOW REAL ROCKETS WORK. You can read more about this later on in this guide.



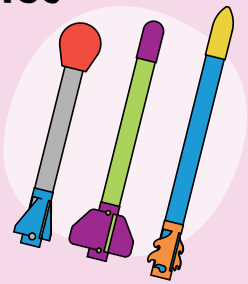
WOW FACT #3 "Farts and rockets: totally twinning"

EXPERIMENTS



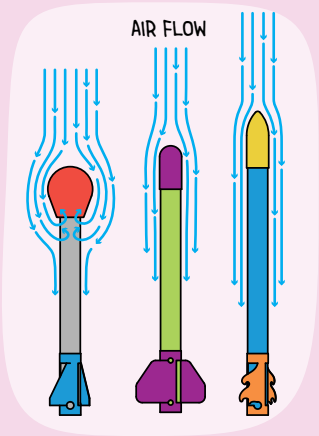
Aerodynamics

Test out each of the **three different rockets.** Which one flies the farthest?



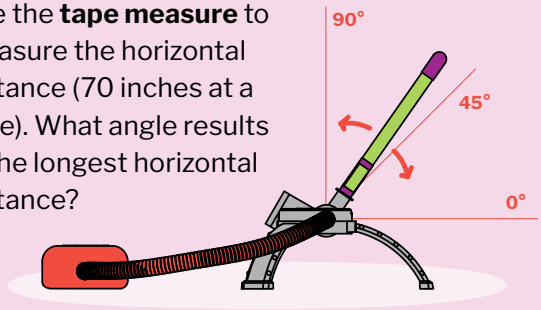
What's happening?

When the rocket flies through the air, it hits air particles, which push on it and slow it down. This is called **DRAG.** The size and shape of the nose cone affects how much drag acts on a rocket. The large, flat red nose creates a lot more drag than the smaller, tapered yellow nose. A shape that reduces drag is called **AERODYNAMIC.** In theory, the rocket with the tapered nose cone should have the least air resistance and should fly the farthest. In practice, there may be other variables that negate the impact the cone shape has on the rocket's flight.



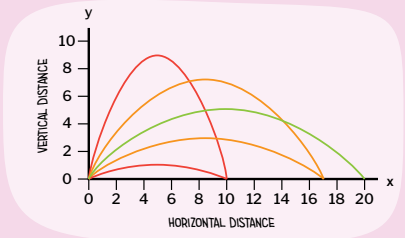
Trajectory

Set the launcher at **different angles** and compare the height and horizontal distance the rocket flies. Use the **tape measure** to measure the horizontal distance (70 inches at a time). What angle results in the longest horizontal distance?

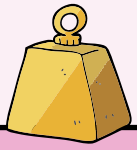


What's happening?

Not taking air resistance into consideration, the ideal launch angle at which the rocket will fly the farthest horizontally is 45 DEGREES, or halfway between vertical and horizontal. Mathematically, this angle yields the perfect balance between how long the rocket stays in the air and how fast the rocket moves horizontally. However, air resistance will affect this too, so the optimal angle is actually a little lower than 45 degrees.



HOW ARE ROCKETS LIKE FARTS?

	ROCKETS	VS.	FARTS
Weight of gas ("mass flow")	Huge: 5.5 tons per second! (1) 		Small: About 1 gram per day average
Speed of gas	Fast: 9,600 miles per hour — 13 times the speed of sound! (2)		Slow: 3 meters per second (7 miles per hour)
Force	Huge: About 8.8 million pounds of thrust! (3)		Small: A small fraction of a pound of thrust
Fuel	Solid fuel: aluminum powder and a salt called ammonium perchlorate Liquid fuel: liquid hydrogen and liquid oxygen		Food fermenting and digesting in the gastrointestinal tract — especially beans, milk, and cabbage! 
Composition of gas 	Solid fuel: water vapor, carbon dioxide, hydrogen chloride, aluminum oxide, and other byproducts Liquid fuel: water vapor		59 percent nitrogen, 21 percent hydrogen, 9 percent carbon dioxide, 7 percent methane and 4 percent oxygen

WOW FACT #5 "It's farty time!"

10,000 MPH

WOW FACT #6 "Fueling up"

Notes: (1) Mass flow for the two solid rocket boosters on the Space Launch System (SLS)

(2) Speed of gas exiting the RS-25 rocket nozzle on the SLS

(3) Thrust produced by the SLS during a launch

THE PHYSICS OF ROCKETS

WOW FACT #7

"It's beginning to look a lot like physics"

Your air rocket's motion and the motion of a real rocket launching into space are explained by **NEWTON'S THIRD LAW OF MOTION.** This is a scientific law which states that FOR EVERY ACTION, THERE IS AN EQUAL AND OPPOSITE REACTION. In other words, when one object exerts a force on another object, the second object also exerts an equal and opposite force on the first object.

Your air rocket and a real rocket engine both produce thrust through **ACTION** and **REACTION.** In the model rocket system, compressing the stomp pad forces air particles through the hose up into the rocket. The air particles collide with the inside of the rocket and bounce backward. In reaction, THRUST is produced in the OPPOSITE DIRECTION which lifts the rocket into the air. Likewise, in the real rocket, the engine produces hot exhaust gases which push off the inside of the rocket, and flow through a nozzle at the bottom of the rocket producing thrust in the opposite direction.

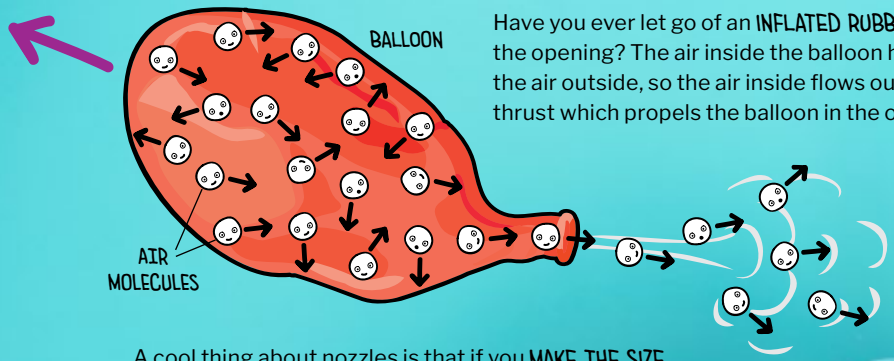
One big difference between the two rockets is that the gas propelling the model air rocket comes from OUTSIDE the rocket, so it is only present at the exact moment of the launch, while in a real rocket, the fuel INSIDE the rocket is burned for a long period of time, allowing the rocket to continue to increase its speed (**ACCELERATE**).

THE SPACE LAUNCH SYSTEM TAKING OFF

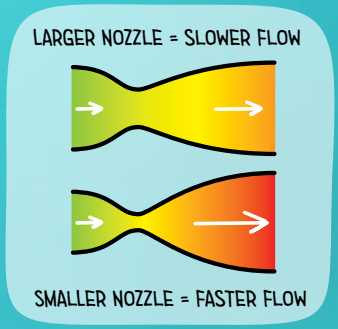
PASSING GASES

Your air rocket is propelled by the gases in air, while real rockets are propelled by the gases produced from the combustion of rocket fuel. In both rockets, **THRUST IS PRODUCED BY GASES FLOWING THROUGH A NOZZLE TO GAIN SPEED.**

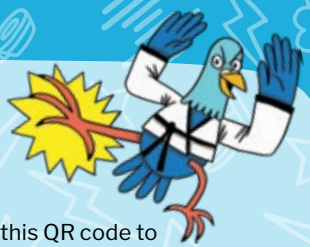
Have you ever let go of an **INFLATED RUBBER BALLOON** before tying off the opening? The air inside the balloon has a **HIGHER PRESSURE** than the air outside, so the air inside flows out the opening. This produces thrust which propels the balloon in the opposite direction.



A cool thing about nozzles is that if you **MAKE THE SIZE OF THE NOZZLE SMALLER, THE GAS FLOWING THROUGH IT SPEEDS UP.** This is because the same amount of matter must flow through a smaller space, and to do this it must move faster. But if the nozzle gets too small, it will get clogged, so you can't get infinite speed.
In this way, the nozzles on rockets not only determine the **DIRECTION OF MOTION** by channeling the gas, they also increase the **THRUST.**



NEXT-LEVEL CHALLENGES



Try these experiments on your own!

1. Make a target on a piece of paper, set it out in a field, and try to hit the target with the rocket.
2. Make your own rocket out of a rolled-up paper tube and a cardboard nose cone and fins.
3. With a stopwatch, time how long your rockets can stay in the air.

Scan this QR code to KEEP THE WOW ROLLING with additional **educational resources** related to this item.

This kit was completed by:

Write your name(s) in the spaces below.

X _____ X _____

X _____ X _____

PLAY IT FORWARD! When you are done playing and learning with this toy, we encourage you to pass it on to another curious kid!

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