Are you the kind of person who hears a tall tale—like the one about the boy whose tongue froze to a flagpole—and then tries to prove whether it’s true or not?

Congratulations! You’re a Mythbuster!

After all, that’s how the pros, Jamie and Adam, got started. The guys didn’t have a giant warehouse full of fancy gadgets like they do today; they just made up experiments using whatever they found lying around their parents’ houses, kind of like the odds and ends they supplied for this kit. Let’s see what they’ve put in your toolbox:

**Toolbox:**
- Baking soda, 0.264 oz (7g)
- Citric acid, 0.264 oz (7g)
- 12 PVC pipes
- 6 Pom poms
- 4 Paper clips
- 8 Brass nuts
- 2 Balloons
- 2 Pipettes
- 2 Soda bottles & caps
- Clear canister
- Measuring spoon

That’s some pretty weird stuff! Can you imagine how any of these things go together?

ADULT SUPERVISION IS RECOMMENDED:
When water is added to a mixture of citric acid and baking soda, the mixture will quickly and intensely bubble which produces carbon dioxide gas. Do not use a sealed container such as a soda bottle with a threaded cap because it can build pressure and burst. Use open-mouth containers such as cups, bowls or canisters when working with mixtures of citric acid and baking soda near water.

Don’t worry, Jamie and Adam sent a special assistant along to help you out. Say hello to Buster! You’re probably used to seeing him in pieces on the ground after he’s been smashed up, blown to bits or thrown off the roof of a tall building. But in secret, Buster’s always wanted to be part of the MythBusters Build Team. Now it’s his turn to watch something else go POP! or BOOM!

Here’s what Buster’s learned from years of experience: Not every experiment works the first time or turns out the way you thought it would. Some of the world’s greatest discoveries were the result of experiments gone “wrong.” The important thing is to use your imagination and keep trying!

Whenever Jamie and Adam are stumped, they go back to the beginning and try to figure out what they could have done differently—this is what scientists call a variable. A variable is the part of the experiment that you can change to affect the outcome. Think about the route you take to school everyday—some days it’s sunny and you get to school on time, some days it’s raining and the trip might take longer. The route stays the same, but the weather—the variable—changes.

There will be lots of variables to test in the myths Jamie and Adam included in this kit, which try to prove some of the stories the guys have heard about air and air pressure. Did you know that the Earth is surrounded by a layer of gases 60 miles thick? It’s almost like we live at the bottom of an ocean of air. Humans have adapted to this environment—we don’t even notice that the air around us has an incredible crushing force. But what do you think happens when we try to use some of that power?

Let’s start busting some myths!
Buster didn't want to test this on himself—just in case. After looking through the toolbox, here's how he decided to prove the Myth of the Dangerous Belch.

**Components:**
1. Clear canister
2. Balloon
3. Measuring spoon
4. Citric acid
5. Baking Soda

**Additional items you'll need:** Tap water, dish rag (just in case)

**Before you start:** Please refer to warning on page 1. This could get messy. Be sure to perform this activity in an area where Mom won't mind a spill.

**All right, Build Team, let's get to work!**

**Step 1:** Fill the canister with tap water to about the halfway mark. Mix in two measuring scopes of baking soda.

**Step 2:** Have someone pull open the lip of the balloon, then carefully pour two measuring scopes of citric acid into the bottom of the balloon.

**Step 3:** Stretch the lip of the balloon over the top of the canister—make sure the end of the balloon with the acid is hanging down. Do not mix just yet.

**Step 4:** Now hold up the balloon and give it a jiggie so that the acid falls into the bottle. Watch the power of air bubbles at work!

**WARNING: science content!**

When citric acid and baking soda are mixed together, a chemical reaction occurs, and one of the products of this reaction is gas carbon dioxide (or CO₂). This is the same gas you find in soda pop. When you open a bottle of pop, some of that gas is released and that's what makes it fizz. With our canister experiment, the balloon kept the gas from escaping; as the gas continued to expand, it created enough air pressure to inflate the balloon. Now think about what happens when you drink a soda: The gas expands in your stomach and makes you feel bloated. When this pressure gets too great, you belch.

**Facts:**
- A burp is the release of gas from the digestive tract through the mouth. In the case of a soda pop, the expelled gas is carbon dioxide, which comes from the drink itself.
- “Burp” and “belch” mean the same thing. If you want to sound annoyingly smart, use the fancier word “eructation.”
- The Guinness World Record for the loudest burp is 119.1 decibels, by Paul Hunn from London, England. That’s louder than a chainsaw!
- Other mammals that burp include cows, dogs, and sheep.

**Fun Facts:**
- A single cow can burp as many as 550-660 liters of gas per day. If you compressed all this gas into a liquid, it would only equal about 1.1 liters. That’s because liquid is denser than air. For example, water is almost 800 times denser than air!

Did you hear the one about the guy whose stomach exploded when he ate a handful of candy mints and then drank a diet soda? Jamie and Adam put Grant, Tony, and Karl on the case to bust this myth. The team used a pig stomach—It wasn’t actually still in the pig—the team might be cruel to Buster, but they’re very nice to animals—and poured the soda into it and added the candy. Nothing happened. The candy has to react with a just-opened bottle of soda to produce an explosion. By the time it gets to your stomach, it’s lost too much fizz to do any damage. Myth—Busted!

**Buster Flashback**

Did Buster get it right? He thought that the citric acid and baking soda would combine to create enough gas to blow up the balloon. Did you get the same result? Is the myth Busted or Confirmed?

**The Myth of the Dangerous Belch is...**

- [ ] Busted
- [ ] Confirmed
- [ ] Plausible

Buster checked his experiment with Jamie and Adam. They had some tips on what he could do differently. Can you come up with a few ideas of your own?

- Try adding more or less baking soda, or more or less citric acid. How do you think this will affect the result?
- What would happen if you used lemon juice instead of citric acid?
**Myth of the Human Weather Forecast**

Is it true that your grandpa’s acting scomb can predict the weather?

Buster’s grandpa retired from doing experiments, so instead, here’s how Buster decided to test the Myth of the Human Weather Forecast.

**Components:**
1. Water bottle
2. Pipette (“Diver”)
3. Brass nuts
4. Paper clips

**All right, Build Team, let’s get to work!**

**Step 1:** Fill the bottle with water, almost to the top. Fill the pipette (Diver) with a small amount of water and slide a brass nut over the opening of the pipette. Now place the pipette into the bottle and then twist the cap on slightly. You may need to experiment a little to make sure you have the cap on tightly, but not too tight. Also you will need to adjust the level of water in the pipette. The tip of the pipette should be 1.4 inches above the water. It’s all about trial and error!

**Step 2:** Give the bottle a squeeze. Does the Diver sink? Now release your hand from the bottle. Does the Diver pop back up?

Did Buster get it right? He thought that changing the air pressure in the bottle would cause the Diver to sink or swim. Did you get the same result? Is the myth busted or confirmed?

**WARNING: science content!**

The concept of buoyancy—whether something floats or sinks—is also known as the “Archimedes’ Principle.” Let’s use our diver as an example. When you first put the diver into the bottle, the diver had enough air inside it to float. When you squeezed the bottle, the air inside the diver expanded (increased in volume) and more water entered the diver. It became heavier and sank. When you released the bottle, the air inside the diver expanded (increased in volume) and the diver became light enough to float again.

Like the diver, people are filled with a mixture of water and gases. When a low pressure system hits, the water weight increases, causing rain to pass through the air around us. The air also holds less gas. This takes the load off the gases in our bodies (like releasing your grip on the bottle), and they expand. Sometimes these gases get trapped in our joints, causing them to ache. So we really can feel the weather in our bones.

**FUN ZONE**

Search for Treasure: Now that you’re an expert at maneuvering the Diver, let’s add some fun to the challenge. Repeat the experiment from Step 1, only this time, drop an unfolded paper clip into the bottle. Then unfold another paper clip so that it has a hook at the tip. Place the straight edge of the paper clip in between the brass nut and the pipette. Place the Diver in the bottle and secure the cap. Test your skills! Can you get the Diver to hook the targets?

What’s the best way to get your Diver to bob for treasure?

**FUN FACTS**

- The deepest living fish are found at 2,440 ft.
- The deepest recorded ocean depth is 36,201 ft.
- Beaked whales dive deeper than any other air-breathing species, down as far as 6,239 ft.
- In 2001, John Bennett became the first Scuba diver to reach a depth of 1,000 ft.
- Wreckage of the ship Titanic was found at 12,500 ft. below the surface.
- Treasure hunters look for sunken ships that might have been carrying gold, silver, or other valuable objects. Some wrecks have been found with treasure worth more than $100 million dollars.

Buster thought “Archimedes” sounded familiar. It’s the name of a famous Greek scientist and inventor who lived more than 2,000 years ago. Some people say that Archimedes was able to set enemy battleships on fire using nothing but sunlight reflected off mirrors. Sibbie and Adam thought this sounded like a whisper of a myth. Of course, the Greeks had to know if they could burst it. They used 127 mirror tiles to reflect the sun onto a wooden flaxing boat. They produced some chaos, along with a small amount of flames. But the ship had to remain completely still, and the sun had to shine full blast on a perfect day with no clouds. That didn’t sound like much of a battle. Myth-Busted!

The Myth of the Human Weather Forecast is...

- [ ] Busted
- [ ] Confirmed
- [ ] Plausible
**MYTHBUSTERS**

**Myth of the Sorcerer’s Breath**

**Did you know you can make objects fly through the air just by breathing?**

Buster is no magician, but he did find a few things in the toolbox to help him prove the Myth of the Sorcerer’s Breath.

**Components:**
1. Pieces of PVC pipe
2. Pom poms
3. Thread

**Additional items you’ll need:**
- Metal targets such as soda cans
- Stickers, paint, etc.
- Additional lengths of PVC pipe

**All right, Build Team, let’s get to work!**

**Step 1:** Using pieces of PVC pipe, assemble your Marshmallow Gun according to the diagram. To make it look extra cool, you can paint your own or add stickers to it—just don’t paint the mouthpiece.

**Step 2:** Load a pom pom into the mouthpiece of the gun. Blow into the top pipe. Ready... aim... and fire!

**? Did Buster get it right?** He thought that exhaled breath would create a powerful enough force to send the pom poms flying through the air. Did you get the same results? Is the myth Busted or Confirmed?

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**WARNING: science content!**

The average pair of human lungs can hold about six liters of air, but only a small amount of that capacity is actually used during regular breathing. Inhaling (breathing in) and exhaling (breathing out) are automatically controlled by the brain—you don’t have to keep reminding yourself to do it. But you can harness more of that lung capacity during what’s called a “forced exhalation,” which is what happens when you blow out birthday candles or shoot your marshmallow gun. You contract (pull tight) the muscles in your abdomen and rib cage, which generate pressure on and force powerful bursts of air out of the lungs.

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Overall, Jamie and Adam thought Buster did a good job with the experiment. They did have a couple of ideas for variables. Can you think of any others?

- Try using mini-marshmallows instead of pom poms.
- Can you load more than one marshmallow at a time? Does this affect aim or distance?
- Try shooting the pom poms into water (a swimming pool, bath tub or sink). What’s more powerful—the force of your breath or the density of the water?
- What effect does the weather have? Can you shoot as far on a hot and humid day?

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**FUN ZONE**

**Target Practice:**
Set up the target dartboard included on the last page of this guide and compete with your friends to see which one of you is the best marksman. Each area of the dartboard is assigned a different point value. Watch where your pom poms hit the board and add up the points. The first one to 30 wins!

**Option:** Make your own shooting range by lining up soda pop cans, Styrofoam cups, toy figurines or other objects.
- How many can you hit?
- What’s the longest distance you can reach?
**FUN FACTS**

- Americans eat about 90 million pounds of marshmallows a year!
- Marshmallows are named after the marshmallow plant, which used to be an ingredient in the sweet. Now marshmallows are made with gelatin.
- PVC stands for polyvinyl chloride. It’s one of the most valuable products of the chemical industry, used mostly in construction. And guess what? It was a totally accidental discovery, made by two separate scientists in the 1800s. That’s trial and error at work!
- Cardiovascular activity, like running and swimming, increases lung capacity. That’s why some world-class athletes have twice the lung capacity of an average human. But you can also increase your lung capacity through activities such as singing or playing a wind instrument like the trumpet or clarinet. Both of these require you to focus your breathing.

**Buster Flashback**

Buster knows what it feels like to be the marshmallow. One time, Jamie and Adam tried to shoot him into outer space. They were testing a myth about a Chinese astrologer who supposedly attached a bunch of rockets to his chair and propelled himself into orbit. Of course, Jamie and Adam decided to let Buster take this risk. They strapped him to a chair, added 70 pounds of gunpowder, lit the fuse, and KABOOM! Buster did not fly to the moon. Not only was the myth busted, but so was Buster. He was damaged so badly that Jamie and Adam had to build Buster 2.0. Myth-Busted!

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**Myth of the Wimpy Tornado**

Did you know that you can test the air out of a tornado, just by opening the windows in your house?

Real tornadoes are dangerous, so Buster came up with a safe and easy method to test the Myth of the Wimpy Tornado.

**Components:**
- Water bottle
- Balloons

**Additional items you’ll need:**
- Ingredients to make your own comix (recipe located in the Front Stone)

**All right, Build Team, let’s get to work!**

**Step 1:**
Take a balloon and stretch it a couple of times. Then hang it inside one of the bottles, stretching the lip of the balloon over the mouth of the bottle. Try blowing up the balloon. Will it inflate?

**Step 2:**
Using a push pin or a thumbtack, create a hole in the bottles, one or two inches up from the bottom. The hole should be about 1/8-inch wide. You might need to ask a parent or adult for help with this step.

**Step 3:**
Repeat Step 1. Now what happens with the balloon? Once the balloon is inflated, place your finger over the hole (or cover it with invisible tape) and the balloon will hold its shape.

Did Buster get it right? He guessed that if he could displace the air in the bottle by creating an escape hole, the balloon would have room to inflate. Did you get the same result? Is the myth Busted or Confirmed?
**WARNING:** science content!

Air is tougher than you think. When you tried to inflate the balloon in Step 1, there was already air trapped in the bottle. In order to blow up the balloon, you would have to squeeze that existing air into the smaller space—and the air fought back. It pushed against the balloon and kept it from inflating. Even though your lungs are strong, the air in the bottle is stronger. But when you pricked a hole in the bottle, the air inside had a escape route, which made room for the balloon. During a tornado, the air pressure inside your house builds up and pushes against the walls. If the pressure gets too great, it can cause an explosion. But if you open your windows—like pricking a hole in the bottle—you create a safety valve to release the pent-up air.

Jamie and Adam liked Buster’s approach. But there were a few options they thought he could try. Can you think of any?

- Does the size of the hole affect how slowly the balloon inflates or deflates?
- Does the position of the hole affect the activity?

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**FUN FACTS**

- Tornadoes can reach up to 300 miles per hour.
- In the USA, an average of 1,000 tornadoes occur each year.
- Tornadoes are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time.

**FUN ZONE**

Time for Some Hijinks:

Jamie and Adam play tricks on Buster all the time. Here’s one they taught him to share with you. Using the bottle without the hole, get your friends to try to blow up the balloon. They’ll waste a lot of hot air. Create a quick diversion and substitute the second bottle with the hole. Now blow up the balloon yourself. Your friends will think you have the lungs of a superhero! Remember, a true magician never reveals his secrets!

Create a Vomit Comet:

Note: Be sure to try this outside or in the bathroom.

Like all of the MythBusters, Buster likes to watch things explode—as long as it isn’t him. He figured out a cool trick to play using the bottles from the experiment. (You probably should try this in the bathroom, basement or garage.) Inflate a balloon in the bottle with the hole, keeping your finger over the hole. Here comes the fun part—really push your friends, fill the balloon with “vomit.” [See vomit recipe below]. Now pull your finger away and watch the vomit squirt all over the place! Try adding sound effects to make people think you’re really throwing up. According to surveys people consider the sound of vomiting the worst in the world. Before you try this trick with your vomit recipe, try it with water!

How to Make Your Own Vomit Recipe:

Jamie and Adam got their start creating special effects for movies, TV and commercials. Today, a lot of these effects are done with computers, but they used to be done by hand—like making your own vomit. Here’s a recipe that Buster likes:

- In a bowl, prepare a packet of instant oatmeal according to instructions, using a little more water than recommended.
- Using a spoon, stir in yellow and green food coloring until you get the perfect disgusting color.
- Optional: Add puffy cereal to make the vomit extra chunky.

You can find other recipes on the Internet—or do what Jamie and Adam would do and create your own vomit from ingredients you have at home. Crumbled vegetables, Lawn, applesauce and sour cream are a great place to start.

**Buster Flashback**

All this talk about trapped air reminds us of scuba tanks. These tanks are used for diving and the air inside them is stored under so much pressure, that if it was released, it would provide 1,3 million pounds of explosive force! In the movie “Jaws,” a scuba tank was used in the film. It was punctured with a bullet and the released air was supposedly powerful enough to blow up the main eating shark. Naturally, Jamie and Adam had to see if this could really happen. They built a model of a shark’s head and put a scuba tank in it’s mouth. Then they rigged it up to fire remotely, and shot a bullet through the tank. The tank didn’t explode—the aluminum was too strong—but the escaped air did propel the tank around the testing container like a rocket. Myth-Busted!
MYTHBUSTERS

BONUS ACTIVITY

Myth of the Floating Train

Have you ever heard that you can make a train float—using nothing but air?

Buster looked through the toolbox, but he couldn’t find a locomotive. So here’s how he decided to test the Myth of the Floating Train.

Collect these components from around your home to bust this bonus activity!

1. Squirt bottle cap
2. CD
3. Balloons

All right, Build Team, let’s get to work!

Step 1: Glue the squirt cap to the CD. Be sure that you completely cover the hole in the disc. Let the glue dry before completing the next step.

Step 2: Check to make sure the cap is closed and firmly attached to the CD. Set the CD on a smooth surface, like a hardwood floor or tabletop. Now blow up one of the balloons and twist the balloon before you stretch it mouth over the cap. Try to do this as quickly as possible, without letting too much air escape.

Step 3: Pinch the cap underneath the balloon and hold the cap base as you twist open the nozzle.

WARNING: science content!

Air pushes down on objects with a force of 14 to 15 pounds per square inch. In the case of a CD, which is about 12 square inches, that adds up to nearly 250 pounds of air pressure! So to lift the CD—or the train locomotive, for that matter—you have to pump more air underneath it than is pressing down from above. The object will float as long as there’s a thin cushion of air below to hold it up.

Buster went back to check his work with Jamia and Adam. They suggested a few ways he could change the experiment. Can you think of some of your own?

• What happens if the squirt cap is open when you attach the balloon?
• What if your own weight is too heavy, or the balloon plus the CD?
• What if you use a different material, like cardboard, instead of a CD?
• Will the craft glide on carpet?

FAMTICS

• Early balloons were made of dried animal bladders. Gross!
• The first balloon was exhibited in 1709; the first CD was manufactured in 1982. How long ago was that? Do you do the math?

Before CDs were invented, people used to listen to music on things called records and cassettes.

This myth reminds Buster of the time Grant, Tory, and Karl wanted to see if it’s true that the blast of air from a passing snowplow could flip a car. Then they built a super-sized plow and tried the experiment again. But no matter how big a plow they used, they weren’t able to flip the vehicle. The plow didn’t create enough air pressure to lift the car. Myth-Busted!

The Myth of the Floating Train is...

☐ Busted
☐ Confirmed
☐ Plausible

So, did Buster get it right? He thought that if he could use the balloon to create a layer of air under the CD—which acted as his train—to help it glide above the floor, did you get the same result? Is the myth Busted or Confirmed?
Target Practice: Are you a real sharpshooter? Cut out the dartboard below, hang it on a
door or wall and let’s see what kind of skills you have with a Marshmallow Gun. (See Page ?)

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