Instructions

You will enjoy this easy, but scientifically researched kit for young experimenters and their parents. It includes an easy-to-assemble rocket kit and detailed launching instructions for launches up to 50 feet in the air. Your rocket is fueled by household supplies of baking soda and vinegar.

ADULT SUPERVISION REQUIRED
To Parents: Please read all instructions before assembly and use.

YES, IT IS ROCKET SCIENCE!
Sir Isaac Newton, the famous English scientist, broke it all down with his three laws of motion back in the 17th century, over 300 years ago.

NEWTON’S FIRST LAW OF MOTION:
Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied. (Also, an object at rest will remain at rest unless an external force is applied).

NEWTON’S SECOND LAW OF MOTION:
The relationship between an object’s mass (m), its acceleration (a), and the applied force (F) is F = ma. Simply put, force equals mass x acceleration.

NEWTON’S THIRD LAW OF MOTION:
For every action there is an equal and opposite reaction.

HOW DO THESE LAWS RELATE TO ROCKET SCIENCE?
Newton’s first law: If you set your rocket on the launch pad and do not apply any external force, it will sit on the launch pad for a long, long time. To get it to move (launch), an external force (not a part of the actual rocket) must be applied to it.
**Newton’s second law:** Because the rocket is heavy (compared to the air around it), a lot of force must be applied to it to get it to accelerate upward (launch).

**Newton’s third law:** The force of the gases shooting out the bottom of the rocket (action) causes the rocket to move in the opposite direction (reaction).

If you have ever blown up a balloon and then let it go so it flies all around the room, you have made a simple rocket fly. The air inside the balloon is squeezed out through the nozzle by the balloon. As the air rushes out in one direction, this force causes the balloon to fly in the opposite direction.

In this example, the squeezing of the balloon causes the air to accelerate out through the nozzle. In rockets which are not made of thin rubber, other methods are needed to accelerate the gases out of the nozzle. For larger rockets, burning rocket fuel does the trick, whether it is liquid fuel, solid fuel or a combination of both. The liquid or solid fuel turns into hot gas when it burns and escapes out the nozzle at a very high speed.

**HOW DOES YOUR ROCKET WORK?**
The Moon Rocket works by using a different type of chemical reaction. Instead of burning liquids and solids to make gas, it mixes baking soda and vinegar to make a gas called carbon dioxide. Acid and water are the leftover liquids that are blasted out of the nozzle with the escaping gas. These are harmless. When the baking soda and vinegar mix inside your rocket, the carbon dioxide starts to build up very rapidly, causing a big increase in pressure. When the rocket cannot hold any more gas, it pushes out through the bottom of the rocket, creating the downward thrust (action) that forces the rocket to launch (reaction). The tighter the rocket is attached to the launch pad, the greater the force produced (thrust) and the higher the rocket will go.

**For Your Safety**
**The Moon Rocket should NEVER be operated without adult supervision**

**Operating Safety Rules:**

**WARNING:**
Like all rockets, your Moon Rocket will take off with a powerful launching thrust. You should always observe the following rules for every launch, and only those 12 and older should operate the Moon Rocket. Adult supervision is required. This is not a toy for young children!

1. Please read all instructions and the science section of this booklet before you begin assembling your Moon Rocket.

2. Do not use any fuel in the Moon Rocket other than that specified in this booklet.

3. Never lean over the top of the rocket. Serious injury could result if the rocket were to launch.

4. Never launch the rocket indoors. Launch outdoors where it will land in the open or on the grass.

5. Never point the Moon Rocket at people, animals, houses, cars, etc. Always launch the Moon Rocket from level ground.
6. After every launch, check to make sure that all of the parts are securely fastened and reconnect them if necessary.

7. For maximum safety, use safety glasses or goggles during each launch. (not included) Keep all observers at least 20 feet from the launching area, and take great care when the rocket is returning to Earth. Do not try to catch a falling Moon Rocket.

8. It can take anywhere from a few seconds to a couple of minutes for the Moon Rocket’s fuel (baking soda and vinegar) to mix and generate enough gas for launching. Do not approach the rocket if it fails to take off. Ask a parent to examine the rocket. When examining or refueling the rocket, always hold the rocket away from your body. Do not point toward yourself, any other person, animal or thing.

9. Always have adult supervision and guidance when operating the Moon Rocket.

**Safety Between Launches:**

1. Clean out the Moon Rocket and launch pad with a drop of dishwashing liquid and water between uses. This should be done every time, because vinegar is acidic and will damage the plastic rocket and launch pad if it is allowed to dry in place. This will reduce the effective life of your rocket.

2. Wear play clothes when operating the Moon Rocket, as the fuel will spray out from the rocket during launches. Stay clear of the launch area for that reason.

**Assembly and Preparation for Each Launch:**

1. Slide the tail fins into the tail unit, making sure you slide the channel of the fin into the groove on the tail unit until it snaps into place. See Figure 1. Make sure all 3 tail fins are secure, and that the tail fin is tightly attached to the Moon Rocket fuselage. Screw the rocket body on to the tail assembly very tightly to make sure there are no leaks.

2. Never fuel your Moon Rocket indoors! Fueling your Moon Rocket will require getting baking soda and vinegar from the kitchen, but not without permission and the assistance of an adult. You will need to add baking soda using the measuring spoon that comes with the Moon Rocket. Put the baking soda into the launch pad post as shown in Figure 2. This should fill up the launch pad post about 1/3 of the way to the top. Look for the fill line and fill up to that point.

3. Pour vinegar into the rocket from the bottom. Look for the fill line and fill up to that point. (See Figure 3.)

4. Hold the Moon Rocket in your hand, with the nose cone of the rocket tipped slightly downward, so the vinegar doesn’t drip out of the fuselage. With your other hand, take the launching pad and slide it on to the tail of the rocket, pushing the two surfaces together until they are in contact, being careful not to spill out any of the baking soda from the launching pad. Be careful not to push the launching pad more than 1/2 to 2/3 of the way into the rocket. (See Figure 4.)

**Caution:** Continue to hold the rocket body firmly with one hand and the launching pad with the other until you place the entire unit onto your level launching site. Never point the rocket at anyone, anything or yourself when you are completing this step.

5. Turn the rocket and launching pad upside down and give them a few gentle shakes, to make sure the baking soda is mixing with the vinegar. (See Figure 5.)
6. Quickly position the rocket and launch pad on a flat level surface for launching. (See Figure 6.) Step back immediately and wait for take-off. You will be able to see the chemical reaction of the baking soda and vinegar bubbling in the body of the Moon Rocket. This means that take-off is only moments away. Do NOT get too close to the Moon Rocket or lean over the top of it during this time. Depending on temperature and other conditions, it may take several seconds or several minutes for the Moon Rocket to have enough pressure to launch.

**If the Moon Rocket doesn’t launch after 3 minutes, abort the launch. HAVE AN ADULT approach the Moon Rocket, grasp the body firmly, turning the rocket away from anyone and quickly remove it from the launching pad. There may be a slight pop, similar to what you might experience when opening a can of soda.**

1. Slide the tail fins into the grooves
2. Pour baking soda into launching pad post up to the fill line marked inside post (about 1/3 way to top)
3. Pour vinegar into the rocket body up to the fill line on rocket body
4. Push the launch pad onto the tail of the rocket about 1/2 of the way in
5. Hold the launch pad and the rocket with both hands and shake gently a few times
6. Quickly place the launch pad and rocket on a flat, level open space. Step back and wait for take-off
TROUBLESHOOTING:
1. Rocket does not launch, or takes too long to launch.
   a. Check to see if the baking soda and vinegar have become mixed sufficiently. If not, the rocket cannot launch.
   b. Check to see if you’ve correctly followed steps 2 and 3 above, and that the amounts of the two propellants were accurate.
   c. Check to see if all of the parts of the rocket and the launching pad are sealed and air tight. If parts are loose, they can be secured with plastic cement. If the rocket body is cracked, it is no longer usable and should be discarded. Any opening in the fuselage of the rocket could result in a pressure leak, which could defeat the ability of the rocket to launch.
   d. Check to see if the baking soda got wet before it mixed with the vinegar and is stuck to the bottom of the launch pad. This could prevent a launch.
   e. If the outside temperature is very cool, the chemical reaction will take place more slowly. To offset this, you can increase the amount of baking soda slightly. This is not an exact science, so some trial and error may be necessary to get to the right amount.

2. Launch Pad accidently pops loose or causes too quick a launch
   a. Check to see if you’ve correctly followed steps 2 and 3 above, and that the amounts of the two propellants were accurate. If so, try reducing the amount of baking soda slightly, to slow down the chemical reaction.
   b. Check to see if the fuels were mixed too thoroughly or shaken too vigorously.
   c. Check to see if the Moon Rocket and Launch Pad are tightly connected; too loose a connection may cause a failed launch.
   d. If the outside temperature is very warm, the chemical reaction will take place more quickly. To offset this, you can reduce the amount of baking soda slightly. This is not an exact science, so some trial and error may be necessary to get to the right amount.

3. Rocket doesn’t reach a proper altitude.
   a. Measure a little more baking soda when adding fuel to the launch pad. More baking soda should create more pressure.
   b. Make sure the rocket and launch pad have a tight fit. The tighter the fit, the greater the pressure for take-off, and the higher the Moon Rocket will fly.

If at first you don’t succeed, don’t get discouraged. The science of rocketry was developed by trial and error. You will experience a few failed launches, but don’t give up. Once you learn the process and adjust your measurements to the current conditions, you will find that your Moon Rocket is very easy to launch. Flights of 50 feet or higher are possible with this product, and you will be able to make successful launches time and time again, especially if you follow all of the directions in this booklet. Good luck and Happy Flying!