GEEK & CO. SCIENCE!

PROJECT KIT

Ages 8+

GiaNT MaRS VOLCANO

THAMES & KOSMOS

Warning.

Not suitable for children under 8 years. For use under adult supervision. Contains some chemicals which present a hazard to health. Read the instructions before use, follow them and keep them for reference. Do not allow chemicals to come into contact with any part of the body, particularly the mouth and eyes. Keep small children and animals away from experiments. Keep the experimental set out of reach of children under 8 years old. Eye protection for supervising adults is not included.

WARNING — This set contains chemicals and/or parts that may be harmful if misused. Read cautions on individual containers and in manual carefully. Not to be used by children except under adult supervision.

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Safety information

WARNING.
Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.
Keep the packaging and instructions as they contain important information.

First aid information

Advice in case any accidents should happen during experimentation.

1. In case of eye contact: Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
2. If swallowed: Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
3. In case of inhalation: Remove person to fresh air.
4. In case of skin contact and burns: Wash affected area with plenty of water for at least 10 minutes.
5. In case of doubt, seek medical advice without delay. Take the chemical and its container with you.
6. In case of injury always seek medical advice.

Poison control

Poison Control Centers (United States)
In case of emergency, your nearest poison control center can be reached everywhere in the United States by dialing the number:

1-800-222-1222

Local Hospital or Poison Centre (Europe)
Record the telephone number of your local hospital or poison centre here:

Write the number down now so you do not have to search for it in an emergency.

Advice for parents and supervising adults

With this chemistry set, you will be assisting your child with experiments to learn about volcanoes on Mars. It is natural to have questions about the safety of a kit that contains chemicals. The equipment in this kit complies with safety standards that specify the safety requirements for chemistry sets. These standards impose obligations on the manufacturer, such as forbidding the use of any particularly dangerous substances. The standards also stipulate that adults should assist their children with advice and assistance in their new hobby.

A. Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.

B. The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.

C. This experimental set is for use only by children over 8 years. For use under adult supervision. Keep this set out of reach of children under 8 years old.

D. Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.

E. The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments. Particular attention should be paid to the safe handling of acids and alkalis (bases).

F. The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply.

While experimenting, please be careful not to let the chemicals come into contact with the skin, eyes, or mouth. It is also important not to let the chemicals get into the hands of young children.

The dye will color things very intensely and may cause stains that can't be washed out of clothing. Keep all tablecloths, curtains, and carpets away from the experiment area.

Plaster should not be swallowed or inhaled. Avoid stirring up plaster dust by working slowly and carefully.

The work area should not be in the kitchen, as chemicals should be kept strictly separate from foods and kitchen equipment. Do not use any containers or tools in the kitchen after you have used them for your experiments. The working area should be cleaned up immediately after carrying out the activity.

Always get any required equipment and chemicals ready before beginning an experiment. The safety goggles are particularly important!

Disposal of included substances: The minimally hazardous substances do not pose any great danger to the environment. So solid waste (e.g., leftover plaster) can be thrown into the garbage can (not the kitchen trash). Let the rest of the liquid plaster harden on newspaper and throw it away afterward. The other liquids can be poured directly down the drain. Be sure to rinse well afterward so that no residues remain behind.

We hope you and your child have a lot of fun exploring the volcanoes of Mars!

Safety rules

Read this before starting any experiments

1. Read these instructions before use, follow them and keep them for reference.
2. Keep young children, animals and those not wearing eye protection away from the experimental area.
3. Always wear eye protection.
4. Store this experimental set out of reach of children under 8 years of age.
5. Clean all equipment after use.
6. Make sure that all containers are fully closed and properly stored after use.
7. Ensure that all empty containers are disposed of properly.
8. Wash hands after carrying out experiments.
9. Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
10. Do not eat or drink in the experimental area.
11. Do not allow chemicals to come into contact with the eyes or mouth.
12. Do not replace foodstuffs in original container. Dispose of immediately.
13. Do not use any eating, drinking, or other kitchen utensils for your experiments. Any containers or equipment used in your experiments should not be used in the kitchen afterward.
14. If chemicals should come in contact with eyes, mouth, or skin, follow the first aid advice (inside front cover of this manual) and contact a doctor if necessary.
15. Never work alone. An adult should always be present. Pay attention to the information on the chemical labels, the "Information about hazardous substances" below, and the information provided with each experiment.
16. Pay special attention to the quantity specifications and the sequence of the individual steps. Only perform experiments that are described in this instruction manual.
17. Always wear eye protection. If you wear corrective eyeglasses, you will need protective goggles for those who wear corrective eyeglasses. When working, wear appropriate protective clothing.
18. Safety rules for plaster: Do not place the material in the mouth. Do not inhale dust or powder. Do not apply to the body.

Information about hazardous substances

Please note the following hazard and precautionary statements for the chemicals contained in this kit:

Plaster (gypsum, calcium sulfate):
Avoid breathing dust. Do not get in eyes, into the mouth, or on skin.

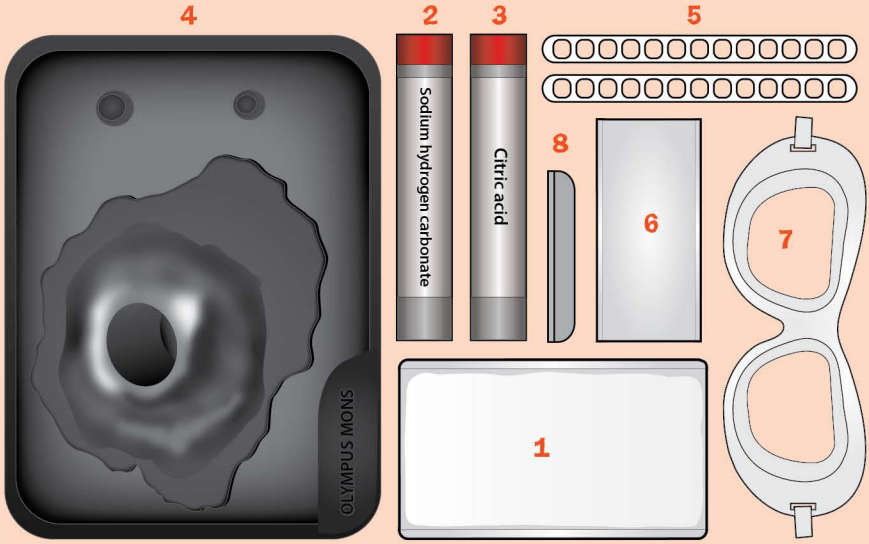
Citric acid:
Causes serious eye irritation
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

WARNING

Sodium hydrogen carbonate and red dye powder: Not hazardous.

Warning. The following applies to all chemicals: Store locked up. Keep out of reach of children. This primarily applies to young children, but also to older children who — unlike the experimenter — have not been appropriately instructed by adults.
Also follow this precautionary statement: IF SWALLOWED: Get immediate medical advice/attention and have product container or label of chemical substance at hand.
If any chemicals inadvertently get onto the skin, rinse off immediately under running water. Always be careful not to inhale chemical dust or powder when experimenting.

KIT CONTENTS



1 | Plaster (gypsum, calcium sulfate), 200 g
2 | Sodium hydrogen carbonate, 27 g
3 | Citric acid, 10 g
4 | Volcano form
5 | Stirring stick (2)
6 | Red dye powder
7 | Safety goggles
8 | Safety lid opener tool

YOU WILL ALSO NEED: *Newspaper, disposable plastic container, spoon, water, flour, small plastic cup, white vinegar, baking soda, two disposable plastic containers, tablespoon, spoon, baking powder, smooth surface*

Hey Mars Explorers!

Ready to make a model of the largest volcano in the solar system? First, you will make a model of Olympus Mons using plaster. Then you can experiment with some volcanic eruptions and modeling lava rocks. Finally, learn about Olympus Mons, how it was formed, and its unique features. Luney the Geeker will be your guide!

PART 1

EXPLORING THE MARTIAN TERRAIN

Modeling the surface of the volcano

You will need:

Volcano form, plaster powder, red dye powder, *newspaper, disposable plastic container, spoon, water*

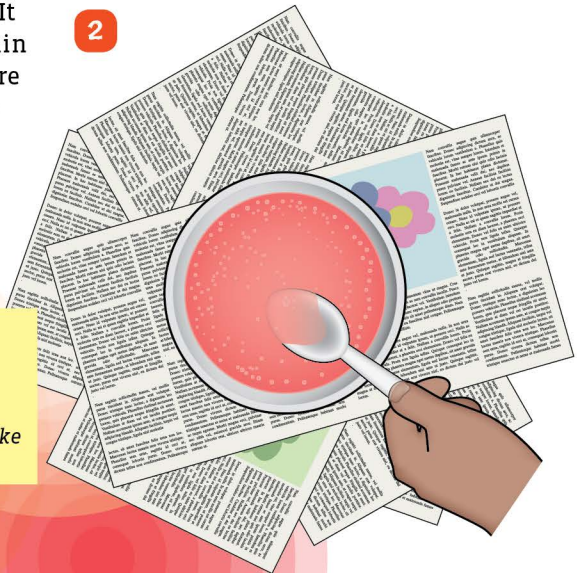
Here's how:

1. Place the black plastic volcano form on some newspaper to protect your work surface.

2. In a clean yogurt tub or other disposable plastic container, mix 300 ml of plaster and 120 ml of water (5 parts plaster to 2 parts water), and half a packet of red dye powder. Stir until smooth. It should be the consistency of thin yogurt. If it's too thick, add more water. If it's too thin, add more plaster.

1

2

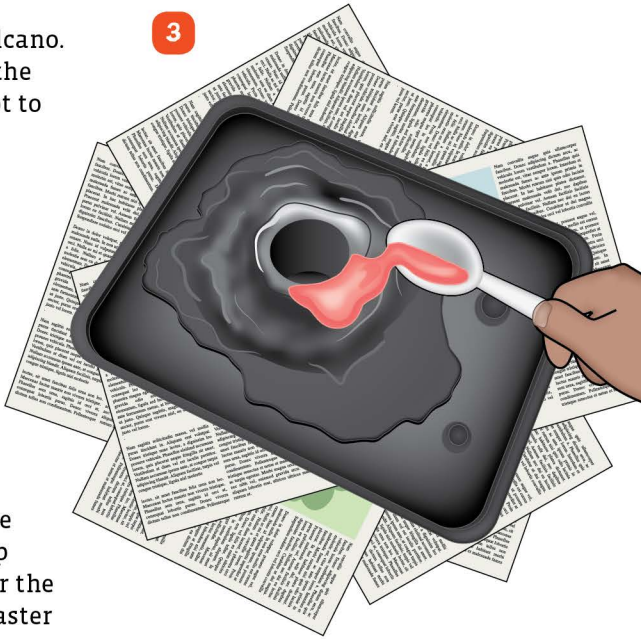


NOTE! The additionally required items are highlighted in italic script in the individual experiments. Before starting the experiments, carefully read through everything that will be required and make sure to have all the materials ready.

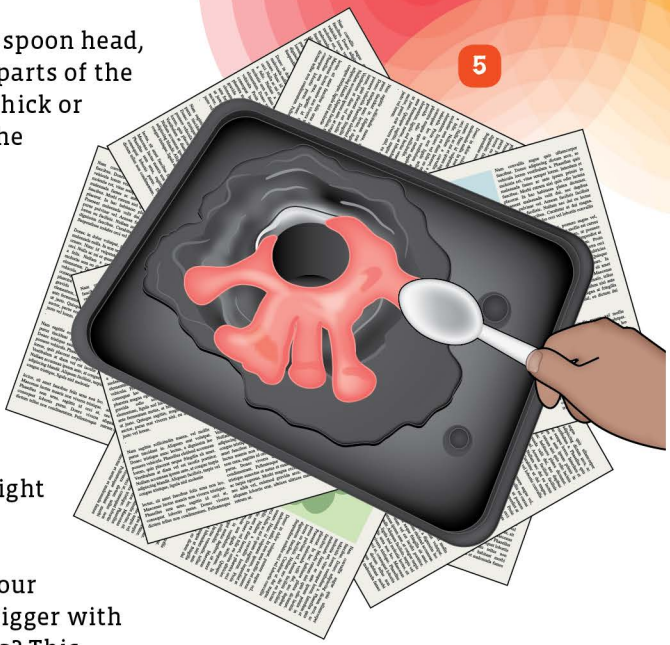
3 Start spooning the plaster mixture on the top of the volcano. Let it run down the sides of the volcano like real lava. Try not to get it into the crater itself.

4 Continue spooning more of the plaster mixture along the entire edge of the crater, allowing it to run down the mountain and cover the surface. Eventually, you want the entire surface of the volcano to be covered with plaster.

The small lip around the base of the volcano form will keep the plaster from spilling over the sides. Don't pour so much plaster on the volcano that the plaster rises higher than the lip at any point around the edge.



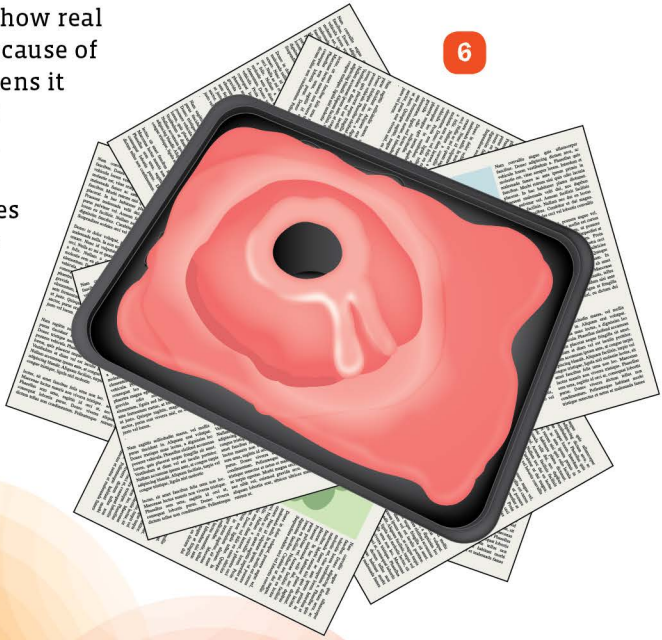
5 With the back of the spoon head, you can smooth out parts of the plaster that are too thick or nudge plaster onto the parts of the volcano form that are not covered yet.



6 You are finished when your volcano is completely covered with lava. Now you have to leave it alone for a day or at least overnight to harden.

Do you notice how your volcano has gotten bigger with this new layer of lava? This experiment recreates how real lava runs downhill because of gravity, and as it hardens it increases the size and height of the volcano.

The red color resembles the actual color of the surface of Mars. Read about it on the next page.



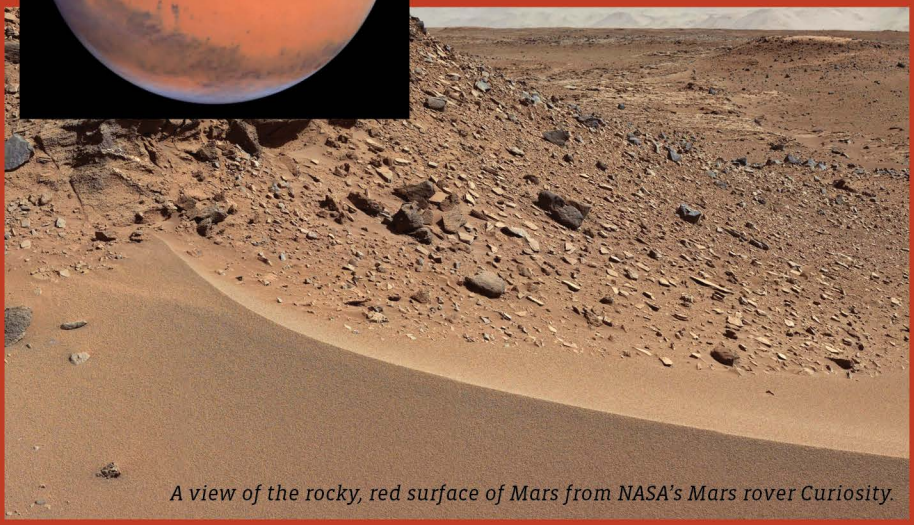
GEEK OUT!

THE SURFACE OF THE RED PLANET

Planet-wide sand storms. Barren, waterless deserts as far as the eye can see. Rocky, treacherous terrain with no plants or animals. Freezing cold temperatures. Sound like a fun place to go? Well, it's the surface of Mars!

Mars has only a little more than a quarter of the surface area Earth has, which is roughly equivalent to the area of Earth not covered by water. The surface of Mars is mostly covered in basalt. **Basalt** is a type of volcanic rock that forms when certain types of lava reach the surface, cool down, and harden. Basalt is also very common on Earth and other planets. It is usually gray to black in color, but because it contains so much iron, it quickly wears down to a reddish-brown color. The iron in it rusts, just like an old metal bicycle chain or iron nail.

All of the weathered and eroded basalt is what gives Mars its distinctive rusty red color. The chemical name for rust is **iron(III) oxide**, also known as the mineral **hematite**. Depending on the other chemicals found in various locations around Mars, the terrain can appear red, brown, tan, gold, and even slightly green. Nobody has yet to see Mars with their own eyes, but many robots have explored and photographed the surface of Mars, sending the images back to us.



A view of the rocky, red surface of Mars from NASA's Mars rover Curiosity.

PART 2

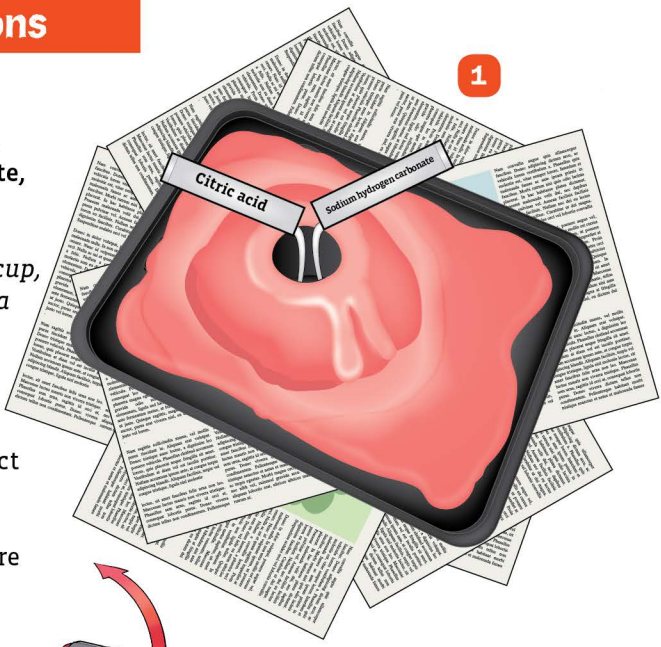
THE GIANT VOLCANO ERUPTS

Experimenting with eruption reactions

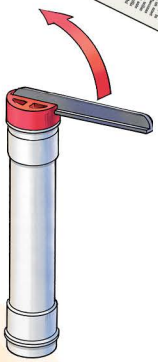
You will need:

Volcano model, citric acid, sodium hydrogen carbonate, red dye powder, stirring stick, lid opener, goggles, *water, flour, small plastic cup, white vinegar, baking soda*

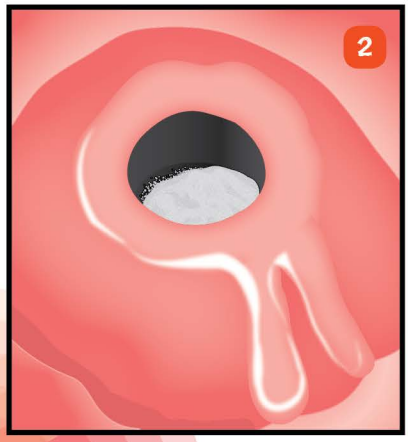
Here's how:



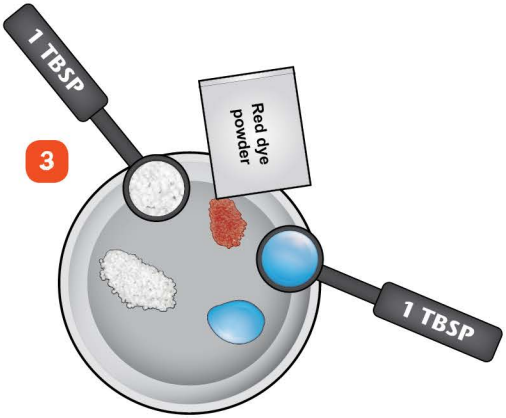
1 Cover your workspace in newspaper to protect it from spills. Use the lid opener to open the chemical vials. Measure and pour the sodium hydrogen carbonate and citric acid into the crater. It should be approximately two parts of sodium hydrogen carbonate to one part of citric acid. You can eyeball it or measure with a small measuring spoon.



2 Mix the two chemicals in the crater with a stirring rod.



3 In a clean yogurt container, mix a tablespoon of flour, a tablespoon of water, and a little red dye. You want a thin liquid that can pour easily, like heavy cream. If it's too thick, add more water.



4 Pour the flour-water slurry into the crater all at once. This will start the eruption.

5 Immediately a chemical reaction occurs between the citric acid and the sodium hydrogen carbonate, which has been activated by the presence of water. The flour and dye add thickness and color to make the erupting solution look more like lava.

This is obviously not the same reason a real volcano erupts, but there are some similar physical properties at play. Read about volcanic eruptions on the next pages.

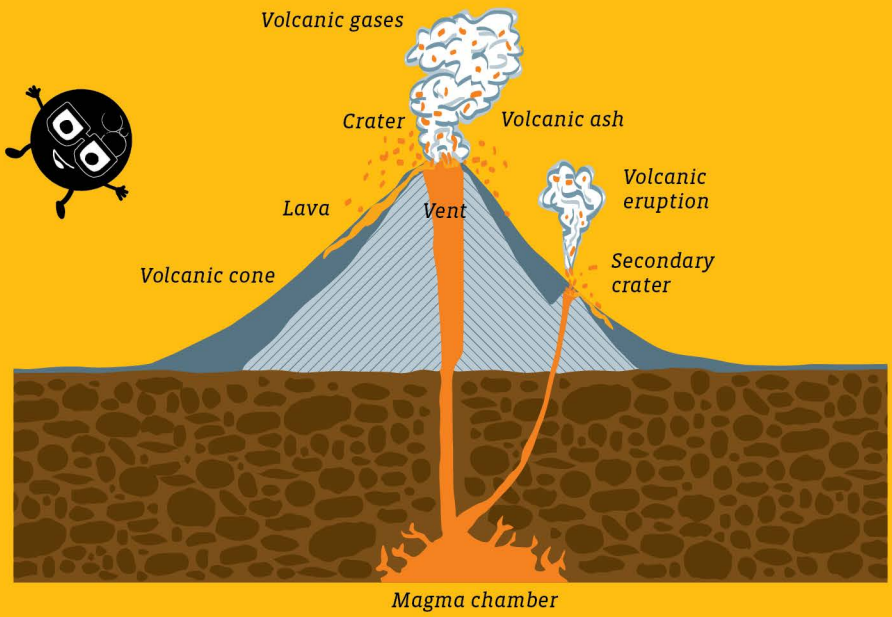
6 You can repeat this eruption a few times with the chemicals included in your kit. Once those are used up, can you simply use baking soda in place of the sodium hydrogen carbonate (it's the same thing!), skip the citric acid, and instead of using water in the flour slurry, use household white vinegar.

GEEK OUT!

ANATOMY OF A VOLCANO

Volcanoes form in areas where glowing-hot liquid rock rises up from a planet's core, where it is very hot, and breaks through the planet's crust. This molten rock is called **magma**. Usually, the magma melts the solid rock of the crust beneath a volcano to form a hollow space called a **magma chamber**. A new volcano typically starts out as a crack in the ground that magma is pushed up out of. The magma is pushed up by the pressure of dissolved gases trying to expand, like when you open a bottle of soda or champagne. In time, the molten rock cools and forms a cone-shaped mountain — the actual volcano. Inside the volcano is a **vent** that forms a bowl-shaped opening — the **crater** — at the volcano's top.

Gases, steam, smoke, fine rocks called **ash**, burning-hot rock debris, and glowing magma rise out of the crater. As soon as the magma gets to the surface, its name changes: now it's called **lava**.



GEEK OUT!

TYPES OF VOLCANOES

The hotter and thinner the lava is, the farther it can flow before it hardens. Volcanoes that expel more liquid lava have flatter shapes. These are called **shield volcanoes** **A** because they look like a giant knight's shield placed on the ground. Olympus Mons is a shield volcano.

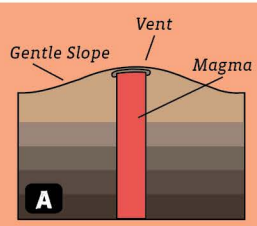
Stickier lava, on the other hand, forms volcanoes with steeper sides. These volcanoes are usually made up of alternating layers of volcanic ash and hardened lava. These are called **composite volcanoes** or **stratovolcanoes** **B**.

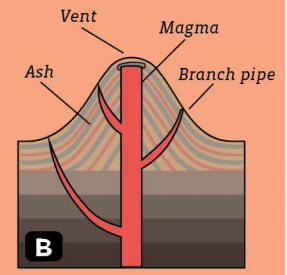
Cinder cone volcanoes **C** are formed when ash, rock fragments, and cinders are violently blown out of the ground into the air and fall down around a central vent. Over time, these grow up into a cone, like a pile of sand at the beach.

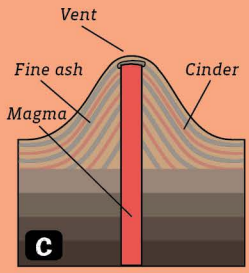
Lava domes **D** form when lava from a volcano is too thick to flow anywhere. It piles up in a bubble or dome shape.

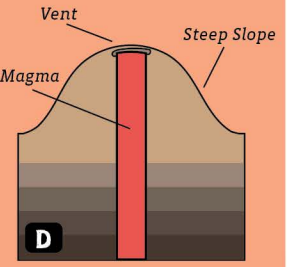
Calderas **E** are bowl-shaped cavities formed when a volcano collapses into the empty space of its magma chamber, after it has emptied out. Olympus Mons has six overlapping calderas that form a giant depression at its surface. Calderas form the largest volcanoes on Earth, such as Yellowstone caldera, which is also called a **super volcano**.

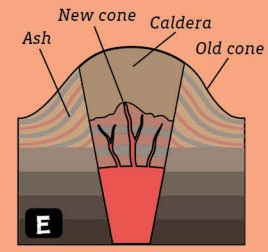
The six calderas on Olympus Mons











PART 3

CHUNKY OR SMOOTH LAVA ROCKS

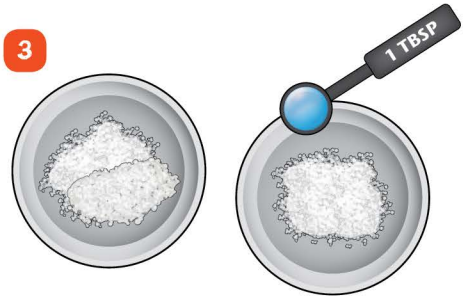
Modeling different types of lava rock

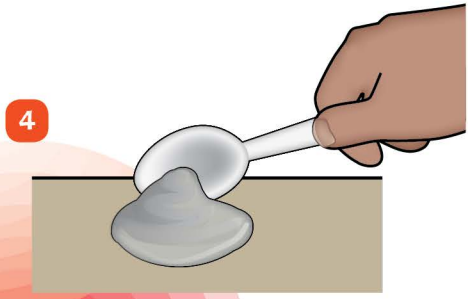
You will need:

Plaster powder, *two disposable plastic containers, tablespoon, spoon, baking powder, water, smooth surface that can get dirty*

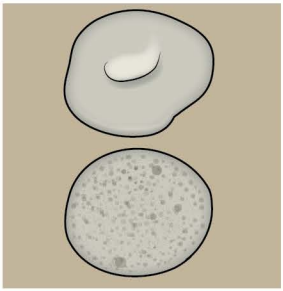
Here's how:

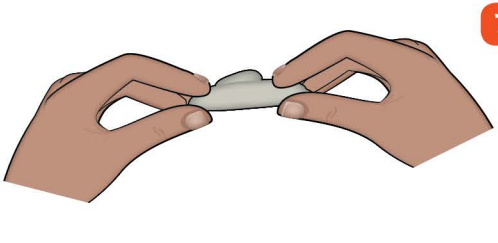
1. Get two plastic tubs ready. Put 1 tablespoon of baking powder in a tub.
2. Put 3 tablespoons of plaster in both tubs and mix.
3. Add 1 tablespoon of water to the non-baking powder mixture. Stir.
4. Spoon a dollop of the plaster onto a smooth flat surface like a disposable plastic container lid. Set it aside to dry.
5. Add 1 tablespoon of water to the baking powder plaster mixture. Stir.
6. Spoon a dollop of this plaster onto a smooth flat surface. Set it aside to dry.





7 Wait for both plaster dollops to dry. This may take a full day or longer. When they are dry, break both plaster "rocks" in half with your hands. What do you notice? Wash your hands and throw away the plaster when you are finished.





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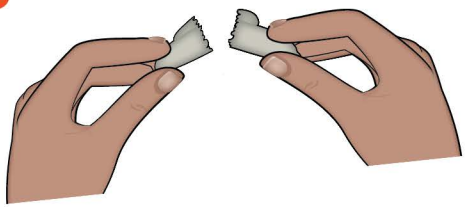


GEEK OUT!

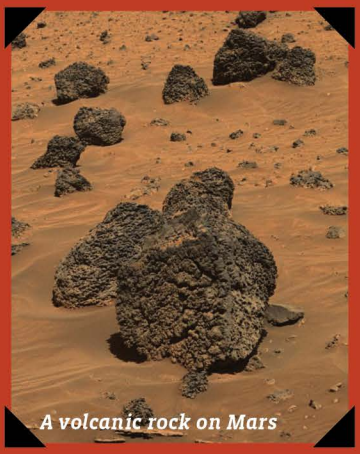
WHAT'S HAPPENING?

Volcanoes produce rocks of many sizes and textures, depending on the chemical composition of the lava, its gas content, and how quickly it cools.

Gas-poor, thin-flowing lava forms a smooth, black surface, which is often pushed together into folds. The name for this type of lava, **pahoehoe**, comes from Hawaii. An example of the type of rock this lava forms when it cools is glassy **obsidian**.

Gas-rich, thicker-flowing lava, on the other hand, hardens into individual, sharp-edged, twisted blocks. This lava is called **ʻaʻa** ("ah-ah"), which also originates from Hawaii. An example of the type of rock this lava forms is porous **pumice**.

In your experiment, the baking powder caused a reaction forming carbon dioxide gas bubbles in the plaster, making it resemble the gas-rich lava.



A volcanic rock on Mars

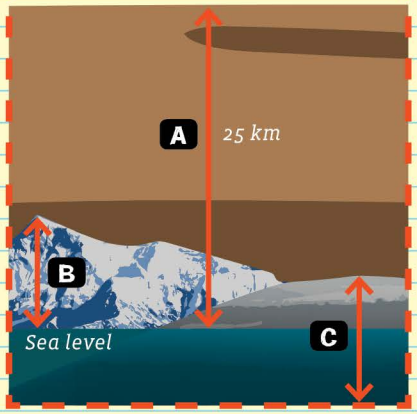
GEEK OUT!

HOW BIG IS OLYMPUS MONS?

Olympus Mons **A** is really, really big! It is 25 kilometers tall and over 600 kilometers in diameter. To put this in perspective, let's compare it to the tallest mountain on Earth and the largest volcano on Earth.

Earth's tallest mountain is **Mt. Everest** **B**. It rises 8.8 kilometers above sea level. That means Olympus Mons is almost three times taller than Mt. Everest!

The largest volcano on Earth is called **Mauna Loa** **C**. Together with some other volcanoes, it makes up the big island of Hawaii in the Pacific Ocean. Mauna Loa rises only 4 kilometers above sea level, but even more of it lies below the surface of the ocean. From its base to its peak, Mauna Loa is 10 km tall. Olympus Mons is still two and a half times taller!



But sometimes you have to look at a diagram to really understand something: The diagram here shows Olympus Mons, Everest, and Mauna Loa approximately to scale. Olympus Mons dwarfs Earth's tallest peaks. One more thing: Olympus Mons is as wide as France!

GEEK OUT!

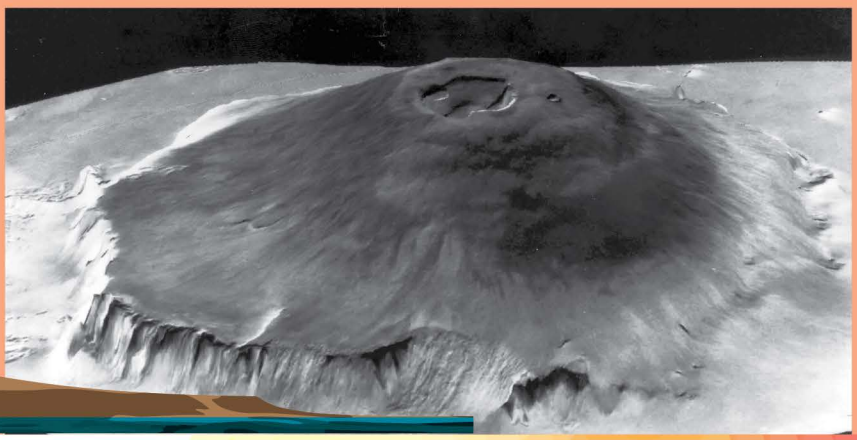
THE VOLCANOES OF MARS ARE BIG!

Volcanoes on Mars formed the same way they do on Earth, except for a couple differences. First, they can grow much larger on Mars — 10 to 100 times larger! Second, they appear to be less active on Mars.

It was once thought that because Martian volcanoes were not formed in chains, as they are on Earth when the crust slides over **hot spots**, that the Mars volcanoes must be extinct. But newer research says they might just be dormant. Because Mars does not have **plate tectonic activity** like Earth, it could be that these giant volcanoes are just lying dormant, waiting for a massive explosion to slowly build up deep inside them. The fact that some Martian volcanoes have few meteorite impact craters, which increase in number over time as objects crash into Mars, means that they are relatively young, and therefore could still be active.

The fact that Mars does not have as much plate tectonic activity also explains why Martian volcanoes can grow so big. On Earth, volcanoes form as the crust slides over fixed hot spots. Because the crust keeps moving, the volcanoes eventually move away from the hot spots and go dormant, and new volcanoes form in the crust that is now over the hot spot. On Mars, since the crust doesn't move as quickly, the hot spots stay under the same portion of crust much longer. The volcanoes are able to erupt over and over again, and grow ever larger. And that's how Olympus Mons got to be so big!

Also, because of the low gravity of Mars, lava flows there might be considerably longer than on Earth, and eruptions might blast volcanic materials much higher and farther away than on Earth.



GEEK OUT!

MARTIAN GEOGRAPHY

The southern hemisphere of Mars has tons of impact craters. It looks like the surface of the moon, which is also covered in craters. This tells us that this region of Mars must not be very volcanically active, because its surface has been exposed to meteorites for long time without fresh lava flowing over it and covering over the craters left by those meteorites.

The northern hemisphere, on the other hand, has fewer craters, many huge volcanoes, and lots of signs of volcanic activity. A number of huge volcanoes can be found in the **Tharsis region**. There are three giant volcanoes in a row: **Ascraeus Mons, Pavonis Mons,** and **Arsia Mons**. To the northwest of these is the enormous Olympus Mons.

Another cluster of volcanoes called the **Elysium region** exists to the west. This consists of three main volcanoes: **Elysium Mons, Hecates Tholus,** and **Albor Tholus**. There are also volcanic plains all over the planet, where channels, slabs, and ridges were all formed by flowing lava a long time ago.

The Tharsis volcanic region

Kosmos Quality and Safety

More than one hundred years of expertise in publishing science experiment kits stand behind every product that bears the Kosmos name. Kosmos experiment kits are designed by an experienced team of specialists and tested with the utmost care during development and production. With regard to product safety, these experiment kits follow European and US safety standards, as well as our own refined proprietary safety guidelines. By working closely with our manufacturing partners and safety testing labs, we are able to control all stages of production. While the majority of our products are made in Germany, all of our products, regardless of origin, follow the same rigid quality standards.

Instructions for using the safety goggles

Item No. 052297

Use The safety goggles are only to be used with the experiment kit. No other type of application is permitted. Wear the glasses in such a way that the eye area is protected. If necessary, adjust the elastic band to the head circumference of the child. The safety goggles should be used together with contact lenses. Wearers of corrective eyeglasses need special safety goggles for people who wear glasses.

Duration of use Always wear the safety goggles when performing your experiments. Not intended for long-term use. The duration of wear should not exceed the time of the experiment.

Storage Store safety goggles at room temperature in a dry room. After the experiment, return them to their place in the kit box, to keep them from being scratched.

Cleaning Do not clean the safety goggles when they are dry. Clean them with plain water and, if necessary, with a mild household liquid detergent, and dry them off with a soft cloth.

Maintenance In case of defective safety goggles or scratched lenses, exchange the glasses for an equivalently constructed pair.

Inspection Check the safety goggles to make sure they are in good condition, and replace them if they are damaged.

Warning Some extremely sensitive individuals may under certain circumstances experience an allergic reaction to skin contact with some materials.

Replacement These safety goggles are available as a replacement part.

The safety goggles are tested per European Directive 89/686/EWG (personal protective equipment).

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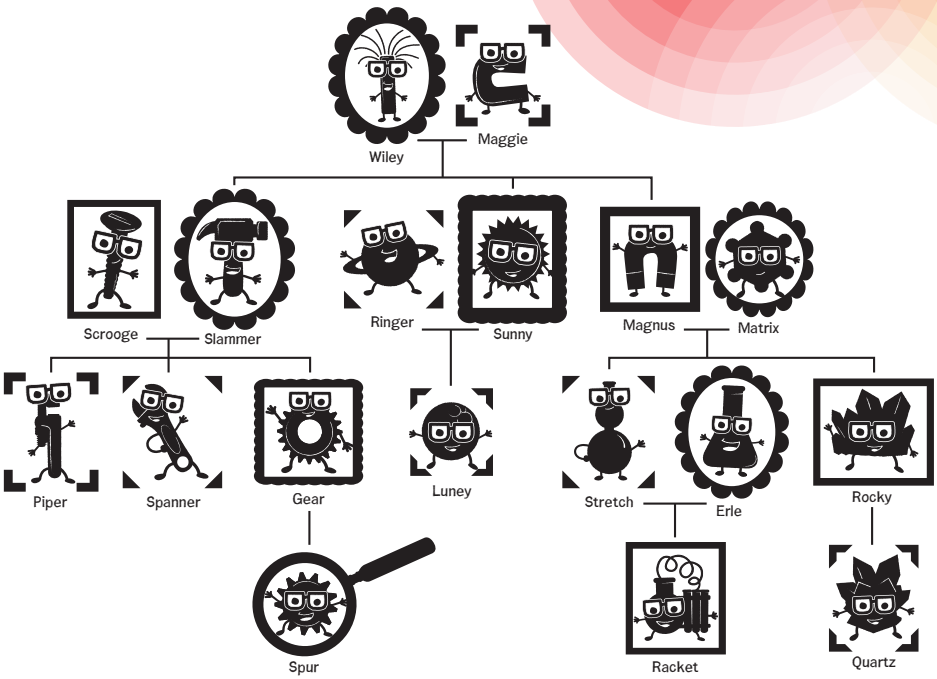
MEET THE GEEKERS!



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