Mars
Olympus Mons

Olympus Mons is the largest volcano discovered to date in our solar system. It is 26 kilometers (16 miles) tall and measures 600 kilometers (370 miles) in diameter — five times larger than Mauna Loa, the largest volcano on Earth. Olympus Mons appears to be inactive.

Ash Cloud

A mixture of glowing hot rock, already cooled rock ash, and water vapor rises high up into the atmosphere. The eruption cloud can be many kilometers high.

Crater

Blown open by the volcano's eruption, the crater is where the rising magma and gases spew out of the volcano. After the eruption, the lava cools down and seals the volcanic vent, often leaving a bowl-shaped depression.

Ash Fall

Powdery ash and small fragments of rock and volcanic glass are propelled many kilometers into the air, raining down around the volcano. The smallest particles can be carried around the entire planet!

VENT

VOLCANIC CONDUIT

Lava Flow

Magma that exits the volcano is called lava. This viscous molten rock flows down the sides of the volcano.

Animals

Many animals have a built-in early warning sense and flee before a volcanic eruption has even occurred.

Magma and gases rise through the volcanic conduit, or pipe, up to the vent. Some volcanoes also have side vents branching off from the main conduit.

Layers upon layers

During each eruption, lava flows out of the volcano and cools down, and ash falls and settles on the ground. In this way, the volcanic mountain builds up layer by layer, eruption after eruption.

- Earth's crust 0–35 km (0–22 mi)
- Upper mantle 35–410 km (22–410 mi)
- Transition zone 410–660 km (250–410 mi)
- Lower mantle 660–2,900 km (410–1,800 mi)
- Outer core 2,900–5,100 km (1,800–3,200 mi)
- Inner core 5,100–6,371 km (3,200–3,958 mi)

Magma chamber

The magma chamber is kilometers below the surface. Molten rock and volcanic gases build up here over time. When it gets too full and the pressure gets too great, its contents rise up through the volcanic conduit.

THAMES & KOSMOS

Massive Erupting Volcano

Instructions for building, painting, and erupting

Do you have any questions?
Our tech support team will be glad to help you!
USA: support@thamesandkosmos.com
or 1-800-587-2872
UK: support@thamesandkosmos.co.uk
or 01580 713000

Checklist:

✔	No.	Name	Quantity	Item No.
❍	1	Potassium dihydrogen phosphate (KH_2PO_4) (EC No. 231-913-4, CAS No. 7778-77-0), 20 g (0.7 oz)	3	724346
❍	2	Sodium hydrogen carbonate ($NaHCO_3$) (EC No. 205-633-8, CAS No. 144-55-8), 20 g (0.7 oz)	3	724347
❍	3	Bag of 2 red dye tablets	1	775717
❍	4	Spatula	1	722970
❍	5	Dark gray liquid paint, 60 g (2.1 oz)	1	724320
❍	6	Orange liquid paint, 60 g (2.1 oz)	1	724321
❍	7	Plaster bandage roll: Cotton fabric with plaster (Calcium sulfate hemihydrate; $Ca_2SO_4 * ½ H_2O$; EC-No. 231-900-3)	8	714846
❍	8	Set of 13 cardboard volcano frame pieces	1	724352

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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.

First Aid Information

- **In case of eye contact:** Wash out eye with plenty of water, holding eye open. Seek immediate medical advice.
- **If swallowed:** Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
- **In case of inhalation:** Remove person to fresh air.
- **In case of skin contact and burns:** Wash affected area with plenty of water for at least 10 minutes.
- In case of doubt, seek medical advice without delay. Take the chemical and/or product together with the container with you. For household substances, take the retail packaging with you.
- In case of injury always seek medical advice.

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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.

WARNING — This set contains chemicals [and 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.

Keep the packaging and instructions as they contain important information.

Dear parents and adults,

This kit allows your child to experience a volcanic eruption up close and safely. Please supervise and assist your child when he or she is experimenting. Before starting the experiment, read the instructions together and follow all of the steps. Your child should work carefully and slowly. Pay particular attention to the following safety instructions.

ADVICE FOR SUPERVISING ADULTS

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 the experimental 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.

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. A solid table with a heat resistant top should be provided; The work area should be cleaned immediately after the experiments have been carried out.

→ Substances in non-reclosable packaging (chemical packets) should be used up (completely) during the course of one experiment, i.e. after opening the package.

SAFETY RULES

- **Read these instructions before use, follow them and keep them for reference.** Please note the quantities and the sequence of the individual steps. Only carry out the experiments described.
- **Keep young children and animals away from the experimental area.**
- **Store this experimental set out of reach of children under 8 years of age.** This includes the unused chemical bags and the built volcano.
- **Clean all equipment after use.**
- **Ensure that all empty containers and non-reclosable packaging** (chemical bags) **are disposed of properly.**
- **Wash hands after carrying out experiments.** Clean your work area.
- **Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.**
- **Do not eat or drink in the experimental area.**
- **Do not allow chemicals to come into contact with the eyes or mouth.** In case of accidental contact with chemicals, rinse immediately under running water.

INFORMATION ON HANDLING CHEMICALS

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.**

Safety rules for handling plaster (from the plaster bandages):

- **Do not place the material in the mouth.**
- **Do not inhale dust or powder.**
- **Do not apply to the body.**

Avoid the formation of dust by carefully cutting the plaster bandages. When building the volcano, quickly place the plaster bandages on the volcano and then wash your hands thoroughly.

Waste disposal:

You can pour the residues of the chemicals used into the sink with plenty of water and rinse well afterward. Other leftovers, such as plaster crumbs, plaster bandages, or cardboard scraps can be disposed of in the household waste. You can wipe up spills with paper towels and dispose of them in the household waste. Pour the colored water carefully down the drain; it could stain the sink.

PRACTICAL TIPS FOR THE VOLCANIC ERUPTION

Set up your work area in an out-of-the-way spot. The room should be inaccessible to small children and animals. The kitchen is not a suitable place for experimenting. There is too great a risk of chemicals being confused with food.

Work on a surface that can get a little messy, for example a wipeable table. Cover the work surface with newspapers before you start, because plaster residues can fall off during the construction of the volcano. Put on old clothes and make sure that there are no delicate objects nearby, such as carpets, rugs, curtains, and so on.

The dye tablets are very potent and can leave stains that are hard to clean.

Choose a place for the finished volcano that is inaccessible to small children and animals, because chemical residues remain on the volcano. Always put newspapers or a large garbage bag underneath it, as some pieces may come loose over time.

Open the chemical packets at one corner using scissors. Never use your teeth. The label should remain legible.

For additional volcanic eruptions, ask your parents or other adults for baking soda and household vinegar. Fill separate, designated containers with these substances before experimenting with them. Do not return foodstuffs to their original containers. Dispose of them immediately (in household waste or drain).

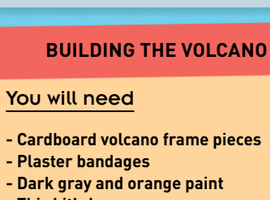
BUILDING THE VOLCANO

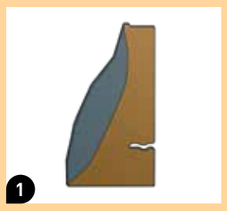
You will need

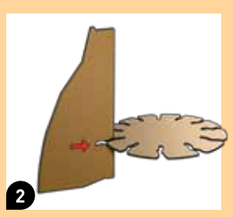
- **Cardboard volcano frame pieces**
- **Plaster bandages**
- **Dark gray and orange paint**
- **This kit's box**
- *Paint brush*
- *Large shallow bowl*
- *Scissors*
- *Tablespoon*
- *Water*
- *Newspaper*

Here's how

1. Decide on a shape for your volcano. If you leave the cardboard frame pieces as they are, you will build a wider, more dome-like volcano. For a narrower volcano with concave sides, cut off part of each frame piece (shaded in the illustration) along the perforated line and use the remaining piece.
2. Insert the 12 long, matching frame pieces into the wavy notches in the round center piece, as shown. Hold the center piece horizontally and the side pieces vertically. Once you have inserted all 12 vertical pieces, your volcano frame is ready.
3. Cover your work area with newspaper and place the volcano frame on it. Now you must cut the plaster bandages into strips. The individual pieces should be long enough to stretch horizontally over the edges of three frame pieces — longer at the bottom and shorter at the top.
   Put some strips aside — you will need them for the volcanic bombs (rocks ejected from the volcano).
4. Fill a large shallow bowl with water. Dip a plaster bandage strip into the water so that it gets completely wet. Lift it up and let it drip off briefly. Note: Refill the bowl whenever necessary; the plaster bandages absorb a lot of water.



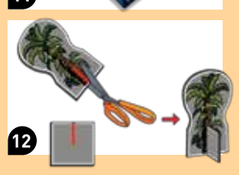




TIP

TO MAKE A VOLCANIC BOMB, CRUMPLE UP A STRIP OF CARDBOARD THAT IS APPROXIMATELY AS LONG AS YOUR INDEX FINGER. WRAP IT WITH A MOISTENED PLASTER STRIP AND LET IT DRY. LATER YOU CAN PAINT IT DARK GRAY. MAKE A FEW OF THESE.

5. Place the moist plaster strip on the volcano frame and smooth it down so that the pores (the small holes in the plaster bandage) close. Make sure that the plaster bandage does not sag between the edges of the volcano. It should be stretched tightly over the cardboard frame.
6. Distribute the wet plaster strips evenly over the entire volcano frame. This works best if each plaster strip overlaps the strip that lies above it halfway. They should not overlap more than halfway, so that the plaster bandages included are sufficient to cover the entire volcano. Do not forget to cover the top of the volcano! Let the volcano dry overnight.
7. Now it's time to paint your volcano. Start with the dark gray paint. Add a few tablespoons of water to the paint and mix it carefully with a brush. By adding water, you dilute the paint so that it is easier to paint the entire volcano.
8. Cover the volcano with the diluted dark gray paint. Apply the paint so that it is darker in some places and lighter in others, resulting in a cool stone look. Keep some of the dark gray paint — you will need it for step 10.
9. Mix the orange paint with a little water. This will allow it to flow down the volcano better. Dip the brush into the paint and press it to the top of the volcano. Repeat this procedure until enough paint has come off the brush and dripped down the side. Proceed in the same way around the top of the volcano.
10. Instead of orange, use dark gray paint in between. The dark gray paint covering the orange paint gives the illusion of cooling lava. Once you have finished painting the volcano, let the paint dry.
11. This volcano is a prehistoric volcano! On the bottom side of the box this kit was packed in, you will find printed dinosaurs and plants on a gray background. Cut the gray areas out of the sides of the box, making sure that the bottom edge remains intact.
12. Now cut out the figures and their feet from the sides. Cut them along the dotted line and slide them together. Arrange the dinosaurs, plants, and volcanic bombs around your volcano before its first eruption.



VOLCANIC ERUPTION

You will need

- **Built volcano**
- **Assembled dinosaurs and plants**
- **Potassium dihydrogen phosphate packet**
- **Sodium hydrogen carbonate packet**
- **Red dye tablet**
- **Spatula**
- **This kit's box**
- *Scissors*
- *Water*
- *Two glasses*
- *Large plastic bag*
- *Hand soap*

Here's how

1. Set up the experiment: Open the kit box and lay its lid on the table. Line it with a large plastic bag to collect the liquid. Make sure the box is completely covered in plastic. Place the built volcano in the middle of the box lid.
2. Break the dye tablet in half and dissolve one half of it in half a glass of water. If it is too hard to break the tablet, get an adult to help you.

TIP

IF YOU WANT TO MAKE THE VOLCANIC ERUPTION EVEN BIGGER, MIX A FEW SQUIRTS OF HAND SOAP INTO THE COLORED WATER.

3. Cut open both chemical packets and empty them into the second glass. Mix them with the spatula. Make sure that no moisture gets into the powder yet, otherwise the eruption will start too early.
4. Now, the eruption can start! Pour some of the powder into the small crater on the top of the volcano. Slowly and carefully pour a little of the colored water over it. The lava will start bubbling! Continue adding chemicals and water until they are used up.

TIP

THE VOLCANIC ERUPTION CAN BE REPEATED AS OFTEN AS YOU LIKE USING HOUSEHOLD ITEMS. INSTEAD OF THE INCLUDED CHEMICALS, START WITH BAKING SODA AND THEN POUR A MIXTURE OF VINEGAR AND A LITTLE HAND SOAP OVER IT.

CHECK IT OUT

WHAT IS A VOLCANO?

There are volcanoes all around the world. Mostly they look like big, harmless mountains. But when a volcano erupts, that's when we get a better idea of what is happening deep inside the Earth below the volcano. During a volcanic eruption, unbelievably **hot lava** flows out of the mountain. Some volcanoes even explode and spew lava and rocks (called volcanic bombs) far and wide. Mere moments after a particularly big eruption occurs, all living things around the volcano are destroyed by the heat, lava, and ashes. What is on the one hand a **destructive natural phenomenon**, on the other hand enables new life: new plants grow on the scorched earth over time and animals repopulate the area. It is quite possible that life on Earth is so **diverse** only because events such as volcanic eruptions resulted in life being regenerated again and again.

Keyword: Lava

The molten rock that is found in Earth's interior is called **magma**. As soon as it comes to the surface and flows out of the volcano, it is called **lava**. At Earth's surface, the lava cools down and becomes solid rock again. A large portion of Earth's surface consists of cooled lava, including large expanses of the **ocean floor**. Lava itself flows like thick ooze and could even be moldable like clay — if it wasn't so incredibly hot (between 500 °C and 1200 °C).

Types of Volcanoes

The **cinder cone** volcano can be identified by the fact that it is often smaller than other volcanoes — with heights of ten to a few hundred meters. To form these volcanoes, lava is hurled into the air, cools, and breaks into individual fragments, called cinders. These rocks fall to the ground around the volcanic vent and build up over time, forming a cone.

The **composite volcano (or stratovolcano)** consists of alternating layers of cooled fluid lava and cinders, which form the recognizable cone shape of the stereotypical volcano. Some of these are among the highest mountains on Earth.

The **shield volcano** is flat and wide, like a warrior's shield lying on the ground. It is created by fluid lava flowing very quickly from its vent and spreading out over a large area. Some of the largest volcanoes in the world are shield volcanoes.

The **lava dome** is a steep mountain created by very viscous lava, which cools down quickly and piles up around the vent. This seals the vent like a cork, often making the next eruption even more dangerous.

Keyword Caldera

The Spanish word **"caldera"** (English: cauldron) refers to the cauldron-shaped cavity that forms at the top of a volcano when it erupts. They are also formed when the magma chamber under the volcano collapses and the cooled lava in the middle collapses as a result. Deep calderas often fill with water, forming a **caldera lake**, pictured above.

VOLCANOLOGY

Volcanology is the scientific study of volcanoes, magma, lava, and related geological topics. A **volcanologist** is a geologist who observes and researches the volcanoes on this planet. They use various techniques to do this: Thermometers that withstand the high temperatures, thermal imaging cameras, equipment for measuring earthquakes, and even **satellites and drones** with which they can observe and measure volcanoes from space. This is particularly useful because approaching volcanoes can sometimes be life-threatening.

Volcanologists can not only reconstruct the history of volcanic activity on Earth with their methods, but they can **also predict new eruptions.** By doing this, they can help save the lives of the people who live near soon-to-be-erupting volcanoes.

Animals seem to instinctively know when a volcano is about to erupt. It has long been observed that animals flee from an area shortly before it is destroyed by lava. Even today, there are strategies to make use of animals' behavior to predict volcanic eruptions.

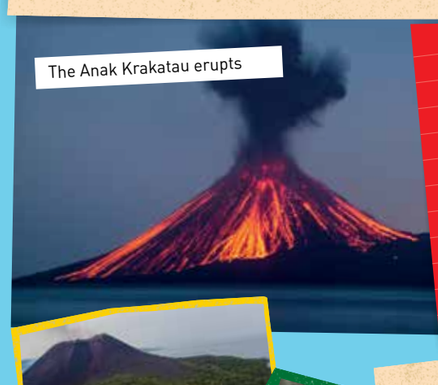
Where can volcanoes be found?

Volcanoes are found all over the world, but as you can see on the map (red markings), they are more common in some parts of the world. To understand why this is so, it is best to remember what a volcano is: a hole in **Earth's crust** through which the magma in Earth's interior can escape.

Earth's crust, however, is not like a continuous blanket that wraps itself entirely around the planet, but rather consists of seven **major tectonic plates** and about 50 **minor plates**. A tectonic plate usually consists of solid land and the surrounding sea bed.

These plates do not lie there static and unmoving: If you look at the big picture, humans are just tiny creatures that are surfing around on gigantic tectonic plates over a very hot ball of molten rock. The tectonic plates are solid, but the layers of rock below them are **many hundreds of degrees** in temperature and thus they are fluid. The slabs of crust float around on this, and where their edges meet, earthquakes occur and mountains are pushed upward. But normally, this movement of the plates is so small that we cannot feel it.

Because Earth's crust is constantly moving, it has many cracks and crevices through which the magma can rise and form volcanoes. Some locations are known as **hot spots**. This means that there is a magma bubble under a plate. Over millions of years, the plate moves over this hot spot, creating one volcano after another — like a string of pearls.



The Anak Krakatau erupts

DID YOU KNOW ... ?

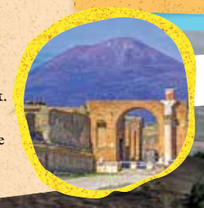
... every day **new land** is created because volcanoes erupt? Most new volcanoes are created under the oceans, but some grow to be so tall that they rise above the water's surface. One example is the **volcanic island Anak Krakatau**, which appeared in the Pacific in 2009. It took only a few days until an island had formed from the strong eruptions. A volcano is only considered extinct if it has not been active for about **10,000 years!**

Forest on Anak Krakatau. It takes only a few decades for nature to conquer the new land!

VESUVIUS

One of the most famous volcanoes in the world, in 79 A.D., **Vesuvius** buried the city of **Pompeii, Italy** under ashes and stone. In addition, a 400-degree shock wave raced over the surrounding area, destroying people and the environment. The victims of the city of Pompeii are still being excavated today — some are still lying there as they were when the volcano erupted.

The victims during excavations in Pompeii



Vesuvius today, in front of it the Ruins of Pompeii

The crater on Etna

DID YOU KNOW ... ?

... that there are many volcanoes that are not on Earth? The **Olympus Mons** on Mars is just one example. Venus has high shield volcanoes. The **Maat Mons**, for example, is 5,000 meters high and is surrounded by gigantic lava flows. There's also **Jupiter's moon Io,** which is a very active volcanic moon whose huge volcanoes emit large amounts of sulfur vapor: fountains of it shoot out of craters to heights of up to 300 kilometers.

Olympus Mons

PREHISTORIC PLANTS

The dinosaurs are extinct, but we have many **plants** that are very closely related to those that grew on Earth in the days of the dinosaurs. The first plant species were conifers and horsetails, followed shortly afterwards by ferns and algae. **Fossils** of these original plant species have been found, some of which are very well preserved.

ETNA

Etna is **one of the most dangerous volcanoes** in the world today. It erupts frequently on the island of Sicily. Its oldest recorded eruption took place in 693 B.C., the most recent in 2019. At almost 3,330 meters tall, it is the highest active volcano in Europe.

ALLOSAURUS

Movement: on two feet
Diet: meat
Height: 3 meters (10 feet)
Length: 9 meters (30 feet)
Weight: 1.4 tons

Allosaurus lived in the Upper Jurassic period about 145 million years ago. It had very **muscular hind legs** that carried its long body, and arms with three claws on them. A recognizable characteristic of Allosaurus was its **two small horns** above the eyes. Its jaw was very mobile and could open wide and also expand sideways. It was mainly found in North America and Europe.

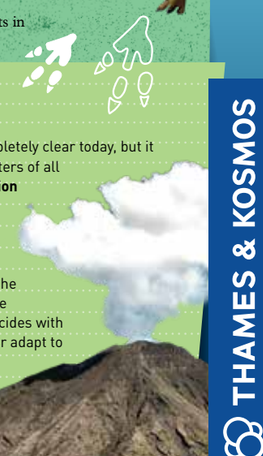
DILOPHOSAURUS

Movement: on two feet
Diet: meat and fish
Height: 2.5 meters (8 feet)
Length: 6 meters (20 feet)
Weight: 500 kilograms (1,100 pounds)

Dilophosaurus lived in the Jurassic period, about 195 million years ago. What is particularly striking is the **double comb** on its skull, which could have had various functions — as a distinguishing feature or means of communication for mating rituals. Fossils of this dinosaur have been found in the USA, but footprints in northern Italy suggest that it also lived in Europe.

Mass Extinction

The reason dinosaurs **became extinct** is still not completely clear today, but it is certain that many dinosaurs and a good three-quarters of all animal species disappeared from Earth about **66 million years ago.** At that time a huge asteroid, a rock from outer space, struck Earth. However, volcanic activity has also been proven to be involved in the extinction of some species. The **dangerous eruptions** threatened not only the living beings in the vicinity of the volcano, but also changed the climate everywhere. The geologic evidence of the increase in temperature coincides with many fossil discoveries. The dinosaurs could no longer adapt to the climate, especially when the high temperatures were followed by a sudden, much colder period.



Keyword: Eruption

The word **"eruption"** comes from the Latin word *"eruptio."* It's not only lava that escapes from Earth's interior during an eruption. Under Earth's surface, gas builds up in addition to magma. The gas must be released through openings like a volcano — otherwise too much pressure is created inside the planet and it bursts open. You have probably seen this phenomenon at home: If you shake a bottle of carbonated soda and then unscrew the lid, the gas escapes explosively!

To this day, clouds of smoke still appear from Mount St. Helens.

Mount St. Helens

In 1980, Mount St. Helens in the US state of Washington erupted: The northern side of the 2,950-meter mountain started to bulge due to a buildup of magma. The heat melted its ice cap. When the water seeped inside the volcano and made contact with the magma, an **explosive mixture** was created. Fortunately, scientists were monitoring the changes in the mountain and were able to give advance warning to the people living there. Today, the area is protected and used mainly for research. The **regeneration** of animals and plants after a volcanic eruption is being studied there.

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