CRACKING ROCKS

This experiment explores "freeze-thaw action," a process that starts when water gets into the tiny cracks of a rock. As the temperature falls at night and rises during the day, this water freezes, then melts... then freezes and melts again. Water is one of the few liquids that expands when it freezes, so, over time, this constant freezing and thawing splits the cracks wider and wider, until eventually even the hardest rock will break into pieces.

The balloon inside this "rock" just has air in it, so the rock didn't break.

AIR AND WATER

Some of these plaster of paris "rocks" have blue balloons full of water inside them to simulate the effect of freeze-thaw action. Erosion—the wearing down of rocks—is an incredibly slow process, but your "rocks" will break open overnight.

HOW TO MAKE

CRACKING ROCKS

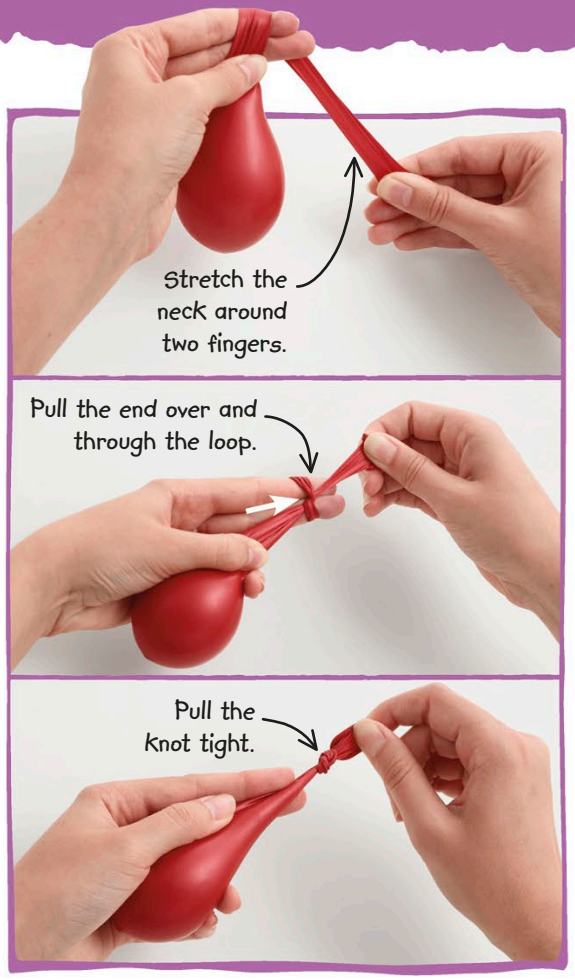
This activity needs patience. You'll be leaving the plaster of paris to set overnight and then keeping it in the freezer the next night. If you have sensitive skin, you should wear protective gloves when handling the plaster of paris.

Time
30 minutes plus 48 hours for drying and freezing

Difficulty
Hard

Warning
Get an adult to help when using plaster of paris

WHAT YOU NEED



1 Blow up the red balloon just a little and tie a knot in its neck. To do this, stretch the neck around two fingers to make a loop, then pass the end over and through that loop, using the groove between your fingers, and pull it tight. If you have trouble, ask an adult for help.

2 Pour water into the blue balloon, until it's about the same size as the red balloon. Tie a knot in it—try not to spill any water!

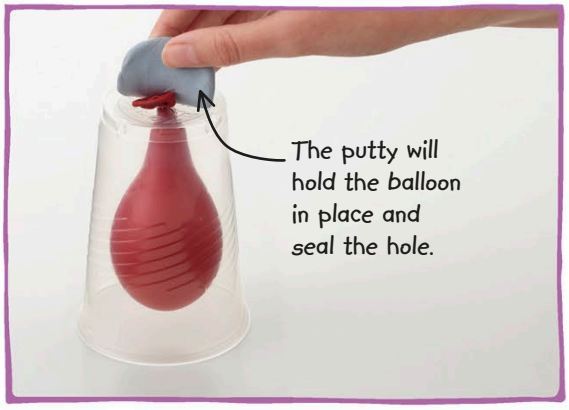
3 Rest a plastic cup on the adhesive putty and make a hole in the bottom using the pencil. Repeat this step with a second cup.

Be careful not to pop the balloon with the sharp end of the pencil!

4 Using the pencil, push the red balloon's knot through the hole in the bottom of one of the cups. Do the same with the blue balloon.

Your two cups now contain a blue water-filled balloon and a red air-filled balloon.

5 Stand the cups upside down. Make sure the balloons aren't so big that they touch the sides of the cups.

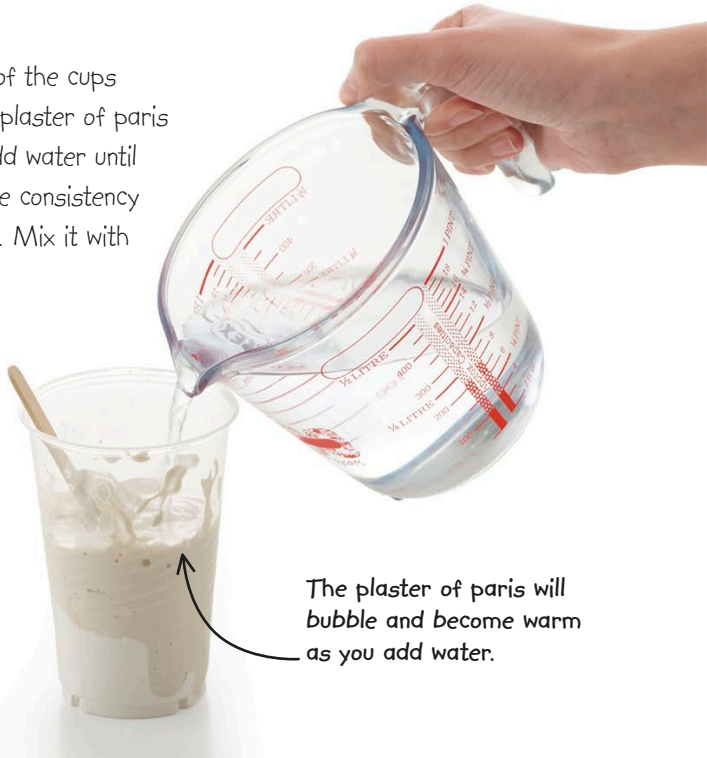


The putty will hold the balloon in place and seal the hole.

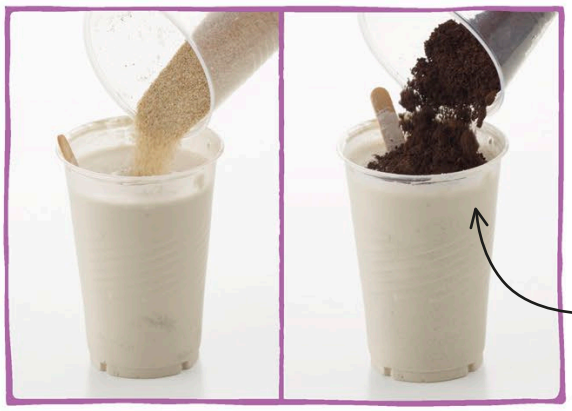
6 Make two flat disks from adhesive putty and press one firmly over each balloon knot.

7 Put each cup you have just prepared inside another cup, to prevent the plaster of paris from leaking in the next step.

8 Take one of the cups containing plaster of paris and gradually add water until the plaster is the consistency of thick pudding. Mix it with the craft stick.

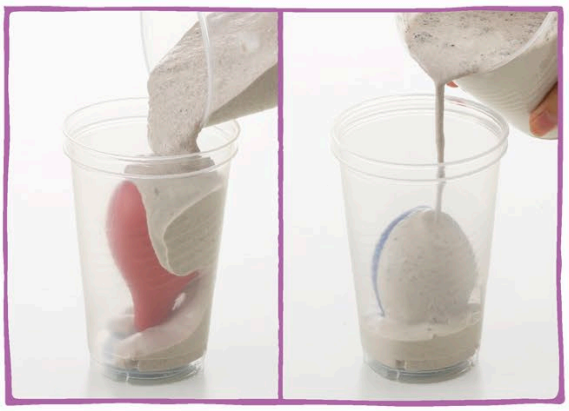


The plaster of paris will bubble and become warm as you add water.



If the plaster becomes too thick, add a little more water and stir.

9 Add some sand and then some soil to your plaster. Mix it well with the craft stick.



10 Pour your plaster mixture over the red balloon. Now take the second cup with plaster of paris in it. Repeat steps 8 and 9, but this time pour the mixture over the blue balloon.

11 You'll now have two cups, each full of plaster, soil, and sand, with the red balloon inside one cup and the blue balloon inside the other. Let them set overnight in a place where they won't get knocked over.

12 The next day, the plaster should feel as hard as rock. Remove the outer cups and pull off the adhesive putty covering the balloon knots.

Leave the knot in place.

13 Cut off the excess rubber above the knot of each balloon. Be careful not to cut off the knot itself or the balloons might leak.

14 Cut a slit in each plastic cup with the scissors, and peel away the plastic to leave your "rocks" with the balloon ends sticking out.

Be careful of the sharp edges when cutting off the cup.

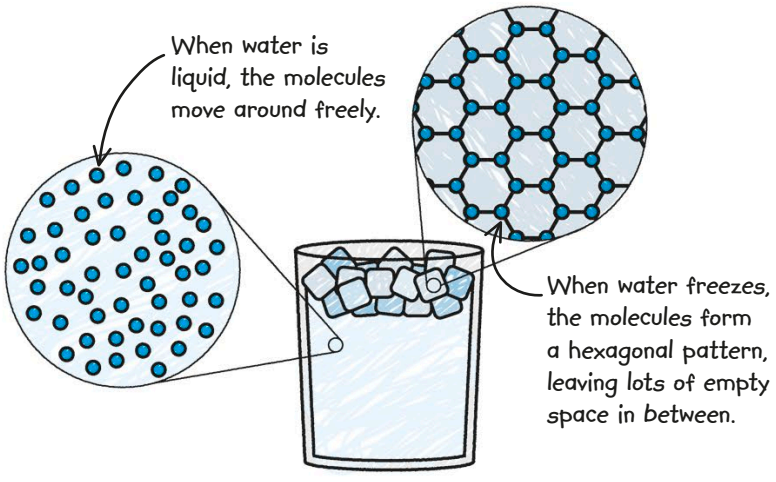
15 Place both rocks in the freezer and leave them there overnight. You could put them on a tray to avoid any mess. The temperature of the water, the air, and the plaster will fall below the freezing point. The water in the balloon will freeze.

The rock with the red balloon inside hasn't cracked because the air didn't expand.

16 The next day, take your two rocks out of the freezer and examine them. You should find the water-filled blue balloon has expanded and broken the plaster.

HOW IT WORKS

Water is made of extremely tiny particles called molecules. Even in a tiny drop, there are trillions of water molecules. When water is liquid, the molecules move around each other, but when it freezes, they lock together in a regular hexagonal pattern. This pattern takes up more space than the molecules did when the water was liquid, which is why the water expands in the freezer, breaking the plaster. By contrast, air molecules pull closer together as they get colder, so the red balloon doesn't affect the plaster at all.



REAL-WORLD SCIENCE

CRACKED ROCKS

Freeze-thaw action frequently happens in deserts, where the temperature can reach 122°F (50°C) during the day, but regularly falls below freezing at night. Freeze-thaw action doesn't just affect rocks, however. The expansion of water as it freezes can crack water pipes in homes, too. It can even break car engines, so people often put antifreeze into their car engine's cooling system during the winter, which prevents the water from freezing.