

What science has taught us about stonehenge

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Even if you don't know much about ancient history and prehistoric monuments, you've probably heard of Stonehenge. The story of this incredible structure goes back more than 5000 years, and while it was certainly important to the people who built it, those architects would have had no way of knowing that their creation would become world-famous. These days, Stonehenge is featured everywhere, from popular movies to your friend's vacation photos. But if there's one thing that everyone seems to know about Stonehenge... it's that there's a lot that nobody seems to know about Stonehenge. The monument is surrounded by famously puzzling questions, like who built it? What was it used for? Who's buried beneath it? And especially: How did ancient people manage to move and erect those huge stones? Over the years, lots of explanations have been proposed, including lost technologies, outright magic, and — of course — aliens. But while speculation is fun and all, Stonehenge doesn't need any help from myths and legends to be cool. After all, just because you understand something doesn't make it any less fascinating — and there is a lot about Stonehenge we understand.

Archaeologists have been intensely studying this structure for more than a century, and while many mysteries still remain, modern science has taught us quite a lot. For centuries, visitors to Salisbury Plain in Wiltshire, England have marveled at Stonehenge and tried to guess at the identity of its builders. One of the earliest written suggestions came from Geoffrey of Monmouth, a bishop famous for his fanciful writings on British history. In the 1100s, he claimed that the monument was built by Merlin. Yep. The wizard Merlin, of Arthurian legend. The story goes that Merlin used magic to

construct Stonehenge as a monument for fallen soldiers, using huge rocks that were originally carried out of Africa by giants. And for a while, this was actually a pretty popular story.

Later scholars got more realistic, though, and proposed a list of non-fictional suspects, including the Romans and the Mycenaeans from Greece. And while artifacts found at Stonehenge indicate that some of those cultures did use or visit the monument in its later years, recent evidence has ruled them out as its builders. A lot of that evidence has come from radiocarbon dating. This method is one of the most useful tools archaeologists have, because it mostly just requires some radioactive carbon. In nature, carbon atoms come in a few different forms, or isotopes, which have different numbers of neutrons. Some of these isotopes — like a key one called carbon-14 — are radioactive, so they break down over time at really predictable rates. By figuring out how much radioactive carbon has decayed in a material, scientists can calculate how long ago the material formed. And that means they can place a date on all sorts of organic substances. Including ones found at Stonehenge. Radiocarbon dating of human remains and artifacts has revealed that the monument's history actually goes back to around 3000 BCE. Which is definitely too old to have been built by the Romans or Mycenaeans... or Merlin! Unfortunately, whatever group made Stonehenge didn't leave behind much evidence about who they were, so their identity remains a mystery.

And the story is complicated even more by the fact that, like many ancient landmarks, Stonehenge wasn't built in a day... or even in a century.

Archaeologists have identified multiple phases of construction at the site
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over a period of about 1500 years, possibly by different groups of people. The earliest construction happened around 5000 years ago, and it involved the digging of the circular ditch that still surrounds the monument. This formation is very similar to a type of earthwork called a henge. We know this partly from carbon dating pieces of tools that were left behind. But we've also found cremated human remains from this period, hiding in pits within the henge. It's possible that some early stones were also put up around this time, but based on other evidence, it's most likely that the famous, giant standing stones didn't arrive for another 500 years. So, even if there isn't enough evidence to say exactly who did the heavy lifting, archaeology has been able to help us understand when it happened, which has ruled out some suspects.

Science has also been able to help us figure out how Stonehenge was built. And one thing is for sure: getting all these rocks into place was no easy task. There are two major categories of stones — also called megaliths — at Stonehenge. The enormous sarsens typically weigh around 22 metric tons each, while the smaller bluestones are a modest 2 to 5 metric tons. Today, there are around three dozen stones at the site, arranged into two outer circles and two inner horseshoes. But based on the holes dug into the ground, there likely used to be more. From what we can tell, workers first dug holes for the rocks to sit in, and then hauled them upright, probably with the help of ropes, A-frames, and lots and lots of people. The standing stones were then capped with horizontal beams to form what architects call lintels, like the beam over the top of a doorway. These were probably lifted up there on wooden platforms that were dismantled after construction. But these

lintels weren't just plopped down. Holes, tabs, and joints were carved into the rocks so that the architects could insert Tab A into Slot B and fit them all together, like a very heavy piece of IKEA furniture. Admittedly, this is some very advanced engineering for that time period, but unlike what a lot of Internet forums say, it's not impossible. The builders might have lived a few thousand years before cranes and power tools, but they still had that good old fashioned human ingenuity... which we tend to overlook. Also, never underestimate the power of a good ramp and pulley system. Archaeologists think major work on Stonehenge continued until around 1500 BCE, and that in that time, more earthwork features were dug, and the bluestones were rearranged multiple times.

But who built the structure and how actually aren't the biggest questions scientists and historians have asked. Instead, the real mystery is how the stones got there. See, the big sarsens are made of sandstone, and the bluestones are variously formed from rhyolite, dolerite, and other types of rock. But none of them match the geology of the nearby area. Thankfully, no matter how far a stone has traveled, it still has the same geologic age and composition as the formation it came from. So, after analyzing the mineral makeup of the stones at Stonehenge, as well as determining their age with other forms of radiometric dating, geologists have been able to go hunting for outcrops that match its features. And we think we've found some answers. Although there's still plenty of debate, many scientists believe the sarsens came from a region called Marlborough Downs, about 32 kilometers from Stonehenge. And the bluestones most likely came from the Preseli Hills of Wales more than 200 kilometers away. A 2015 study from the journal

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Antiquity even identified a site that not only matches the geology of the bluestones but also shows evidence of quarrying during the right time period. The researchers have suggested this might actually be a site where Stonehenge rocks were extracted. Which is pretty amazing.

Of course, that still doesn't explain how people moved the rocks. It seems like an overwhelming task, to the point where it's been proposed that the rocks weren't moved by humans at all. For once, though, I'm not talking about aliens. I'm talking about glaciers. It's been suggested multiple times that these huge stones may have been glacial dropstones, carried by advancing glaciers and deposited when the ice receded. But modern archaeologists tend not to agree with this. For one thing, they point out that there's a lack of good evidence for glacial activity on the Salisbury Plain. We don't see any major piles of glacier-carried rocks, and certainly no deposits of the type of stones used to build Stonehenge. And for another, they argue you don't need glaciers to explain the movement of these megaliths. Again, human ingenuity is enough. For example, some researchers think the rocks may have traveled over water. Ancient peoples could have loaded them onto boats and carted them along rivers and coastlines. Some people have even traced out specific waterways that could have taken the bluestones from the Preseli Hills in Wales all the way to Stonehenge. On the other hand, the stones could have also moved over land. In 2016, a group of students from University College London conducted an experiment to test just how hard it would be to move a megalith. Inspired by technologies from ancient Japan, they constructed a large wooden sleigh laid on top of a path of wooden logs. They put roughly one-metric-ton of stone on the sleigh, and pulled it across

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London's Gordon Square. With only ten people pulling, they were able to move the rock up to three and a half kilometers per hour. So maybe Stonehenge architects used a similar technique. Or, like other scientists have pointed out, maybe they just rounded up a bunch of people and carried the rocks. All in all, it's hard to say which of these ideas — if any — is closest to the truth, because no one has found any direct evidence of a transport route. It has, after all, been an awful long time. But there's good reason to suspect people were at least capable of moving these megaliths without any help from magic or tractor beams.

Historians are still investigating why they might have gone through so much trouble, but either way, with all of the hard work that went into building it, it's pretty clear that Stonehenge was important. It may have served a number of purposes, but scientists know for sure that it was a long-used burial ground. The cremated remains of more than 60 people have been extracted from beneath the monument, and it's estimated that there may have been more than 150 burials at the site over its centuries of use. For a long time, we didn't know who these people were, but recent research has begun to unravel that mystery, too. New excavations at Stonehenge in 2008 opened up the doors for more modern scientific analyses on these remains, including a technique called stable isotope analysis. Unlike radiocarbon dating, this method looks at isotopes that haven't decayed much over time. And instead of being used to determine age, it can be used to examine the chemical makeup of remains. Kind of like the stones themselves, the bodies at Stonehenge hold the chemical signatures of the environments they lived in, picked up from the water they drank and the locally-grown food they ate.

That can tell scientists where they likely lived. A 2018 study in Scientific Reports found that some of the bodies had isotopic signatures that matched the local environment. So these were probably people who lived nearby. But others had signatures pointing to more distant regions like Devon or Wales. Since these signatures are also affected by the type of wood used for the cremation process, It's not yet clear exactly who these people were, but it seems people from near and far were buried here, maybe because their relatives were, or because this site was used by a culture that was often on the move. More digging and more research will hopefully tell. Regardless, whoever it was that built, used, and buried their dead at Stonehenge, we do know that they weren't alone. Whether because of the environment or other factors, the Salisbury Plain is one of the richest archaeological regions in the world. There are hundreds of other burial sites and ancient remains, and researchers have used all kinds of cool methods to investigate them — including ground-penetrating radar and lasers.

So there may still be a lot of mystery surrounding Stonehenge, but those questions aren't unanswerable. And as we keep researching and introducing newer technologies, more science — and more knowledge — is yet to come