

MARVEL THE SCIENCE OF



SUPERHEROES



EXPLORE THE REAL-WORLD SCIENCE BEHIND SUPERHUMAN POWERS



SPIDER-MAN

The science behind Spider-Man is very interesting. I like him, but I would definitely NOT have named myself after an arachnid. Also, that's not how I would've made those webs, but I like what he did there. It must be some type of polymer. Cool. I've met more than one spider-guy, but I'm not sure how many there are.

- HOW DID SPIDER-MAN GET HIS POWERS?
- WHERE DOES SPIDER-MAN GET HIS WEBS FROM?
- WHAT GADGETS DOES SPIDER-MAN HAVE?
- DO THE DIFFERENT SPIDER-MEN HAVE DIFFERENT POWERS?
- HOW DO DOCTOR OCTOPUS'S ARMS WORK?
- CAN THE VULTURE REALLY FLY?



SPIDER-MAN: ALLIES

Spider-Man has teamed-up with countless other heroes in his crime fighting career, but there are some that he counts as friends.

DAREDEVIL

A childhood accident robbed Matt Murdock of his sight, but enhanced all his other senses beyond normal human ability. Matt has a 'radar sense' that allows him to perceive the world around him, and his enhanced senses give him abilities far beyond a normal person. A skilled martial artist, he protects Hell's Kitchen in New York as the super hero Daredevil.

IN THE REAL WORLD

Daredevil's radar sense is similar to echolocation, which is used by bats. A bat will send out a sound and then wait for the sound waves to bounce off an object and produce an echo. When the bat hears the sound of the echo, it can determine the size and location of that object. Human ears are less sensitive than bat ears. When sound waves hit a human's ear drum they trigger nerve signals that are sent to the brain and interpreted as sounds. In theory, if someone's ears were more sensitive to sound, their brain could interpret a much wider range of sounds.

BLACK CAT

A brilliant cat burglar, Felicia Hardy was initially one of Spider-Man's villains, but the two fell in love and briefly dated. The Black Cat didn't have any super powers when she first appeared in *Amazing Spider-Man #194*, but later she asked the Kingpin to give her super powers as a way of keeping up with Spider-Man. She developed a 'bad luck' field, which meant that anyone who tried to attack her developed instant bad luck; their guns would jam, they would trip over their shoelaces or something else unlucky would happen to them.

IN THE REAL WORLD

There are lots of superstitions about luck, many involving black cats. In some parts of Scotland and Wales black cats are seen as good luck, bringing prosperity and wealth. However, other cultures have traditionally associated black cats with witchcraft, and see them as unlucky. In the real world you can't change how lucky you are, because if you could then you would win the lottery every week!



BEN REILLY

It isn't easy being Spider-Man, but it's much harder being a clone. Ben Reilly is a clone of Peter Parker created by the Jackal - he has all of Peter's abilities and a copy of his memories. For a long time, Ben thought that he was the original and Peter was the clone, and Ben had a hard time coming to terms with the fact that he is not the original Spider-Man.



IN THE REAL WORLD

No humans have ever been cloned in real life but other animals have been. In 1996 scientists in Scotland cloned a sheep called Dolly, and in 2018 scientists in China cloned two long-tailed macaque monkeys. It is possible to clone a human embryo, but there is no solid scientific evidence that anyone has cloned a human, and it is illegal and unethical. Most of the scientific research into human aging has been about how to stop it, not how to speed it up, so it's unlikely we'll see cloned humans anytime soon.



SPIDER-WOMAN

Jessica Drew was experimented on as a child and was subjected to radiation that contained spider DNA. She developed spider-based powers including super human strength, speed, stamina, agility and reflexes. She is also able to shoot electricity from her hands in discharges that she calls venom blasts. She's also immune to radiation and most poisons.

IN THE REAL WORLD

Scientists have been working on understanding DNA for years. DNA (short for deoxyribonucleic acid) is the code that tells your body how to grow into you. Changing this information is called genome editing, and would involve rewriting the instructions that make up the building blocks of a human being. Scientists have been studying genome editing as a way of preventing diseases, and are looking at how genetic sequences that cause diseases can be altered.



THE AVENGERS: CAPTAIN AMERICA

Several heroes have taken the mantle of Captain America, serving as a sentinel of liberty and a beacon of freedom. Captain America is more than one person, he is a symbol of standing up for what is right. Steve Rogers started the legacy of Captain America during the darkest days of World War II, but other heroes have picked up the shield.

SUPER SOLDIER SERUM

During World War II, Doctor Abraham Erskine created a medical process, known as the Super Soldier Serum, which was designed to unlock the potential of any subject. The first recipient was Steve Rogers who was immediately turned into a peak human specimen. Steve gained superhuman-enhanced strength, durability, speed and endurance, as well as accelerated healing and decreased aging. Doctor Erskine was shot shortly after Rogers was given his powers, and this serum has never been successfully replicated.

IN THE REAL WORLD

Scientists in Ohio have been working on different treatments that increase muscle mass and strength. These treatments could help people with degenerative muscle diseases, where muscles waste away. The treatment works by stopping genes that halt muscle growth, so muscles become bigger, up to a certain point. The treatment takes six weeks, which is much longer than the few seconds it took for Steve Rogers to become a super soldier.



SAM WILSON'S WINGS

The original wings used by Sam Wilson were designed by Black Panther and made of lightweight titanium. They used solar-powered receptors to power jets under the wings and in his boots, allowing him to fly at speeds of up to 250 mph. The wings have since been upgraded and are now strong enough to protect Sam from bullets, projectiles and weapons.

THE WINTER SOLDIER'S ARM

James Buchanan 'Bucky' Barnes was the best friend of Steve Rogers, before he was captured and brainwashed into becoming a fearsome assassin cyborg. He has since managed to break his programming, and briefly took over as Captain America when Steve Rogers was thought dead. Bucky's left arm is a cybernetic prosthetic, which gives him superhuman strength and speed. It can even work when it is not attached to his body!

CAPTAIN AMERICA'S SHIELD

Cap's red, white and blue shield is an iconic symbol, not only of the character, but of freedom itself. The shield is a disc made of a lightweight Vibranium alloy. It is virtually indestructible and nearly always returns to Captain America whenever he throws it. It's bulletproof and fits neatly on Cap's back whenever he isn't using it.



IN THE REAL WORLD

Powered electric wingsuits allow gliders to control their flight to a degree that is pretty close to Sam Wilson, just by using a lightweight battery and two propellers. At the moment, you need to jump out of a helicopter as you can't take off from the ground, which sounds pretty scary!

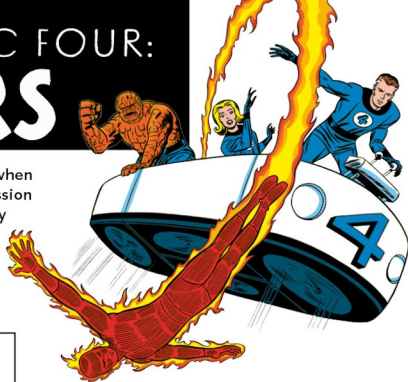


IN THE REAL WORLD

It's possible to create a heavy-duty shield that can stand most blows, and it's possible to create a lightweight shield that can bounce off things and return to the thrower's hands, but so far nobody has managed to combine the two.

THE FANTASTIC FOUR: POWERS

The Fantastic Four got their powers when Reed Richards took the team on a mission into space where they were blasted by cosmic rays, changing them forever. They are a team of explorers, adventurers and heroes who have saved the world countless times.



REED RICHARDS: MISTER FANTASTIC

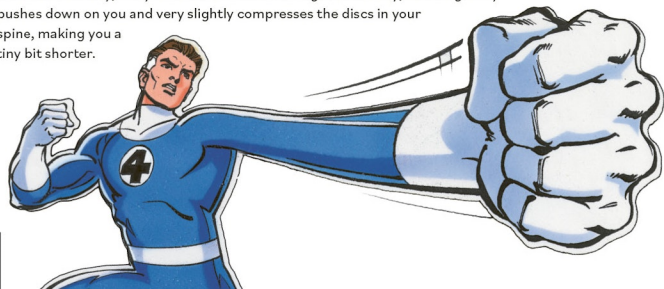
Reed Richards is one of Earth's greatest scientists, and his body is as elastic and malleable as his brilliant mind. After his exposure to cosmic rays, he gained the ability to stretch his body out and make himself hundreds of feet long.

IN THE REAL WORLD

The world record for stretchiest skin was set in 1999 by Garry Turner, who stretched the skin on his abdomen 15.8 cm (6.25 in). His skin was so stretchy that he was able to pull the skin from his neck completely over his lower jaw.

COULD YOU STRETCH LIKE MISTER FANTASTIC?

Your body does change over the course of a day, but only very slightly. You are tallest when you wake up in the morning, and you may be as much as a centimetre shorter by the end of the day; but you haven't shrunk. Throughout the day, Earth's gravity pushes down on you and very slightly compresses the discs in your spine, making you a tiny bit shorter.



SUE STORM: INVISIBLE WOMAN

Susan Storm Richards is perhaps the most powerful member of the Fantastic Four. She can turn herself invisible and can create weapons and invisible force fields that are limited only by her willpower.

IN THE REAL WORLD

A company in America has created a material which could turn you invisible! It works by bending light through a very thin material so that you cannot see anything behind it. It's not perfect, and at the moment it works more like an invisibility cloak, but they are working on ways to turn it into an invisibility suit.

COSMIC RAYS

Cosmic rays are real but we don't know a lot about them. They are parts of atoms that move through space at nearly the speed of light, which is about 670,000,000 miles per hour. Cosmic rays are harmless, but on Earth's atmosphere we are protected from most cosmic rays by a magnetic field around the planet. Astronauts do get hit by cosmic rays, and to a lesser extent so do airline crew and pilots, but none so far have developed any super powers!

