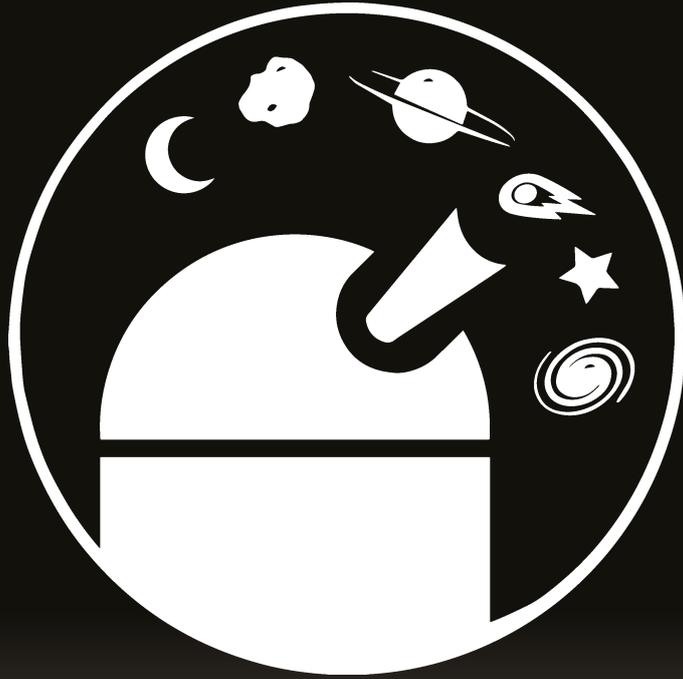


# All About Space



## THE FIGHT FOR MARS



The fight for Mars

**EXCLUSIVE: ELON MUSK AND RICHARD BRAN**

# THEIR FIGHT

# MMA



It's the battle of the billionaires: two of the private space industry's most exciting companies - SpaceX and Virgin Galactic - go head-to-head and they're proving to be fiercely competitive



**SON REVEAL**

**FOR**

**MARS**



# The fight for Mars

There are many similarities between Elon Musk and Richard Branson. For a start, both are serial entrepreneurs: Branson runs the British multinational Virgin Group which has interests in health, entertainment, publishing, travel and motorsport, while Musk is the co-founder of PayPal, the chairman of SolarCity and the chief executive of Tesla.

As a consequence, they are both billionaires, and very well-respected ones at that. Musk may only be 47 years old but, as a brilliant engineer with one of the greatest minds of a generation, he is often favourably compared to the equally genius (yet fictitious) Tony Stark of *Iron Man* fame. Branson is, at 68, 21 years his senior, yet he has proved to be equally worthy superhero in his endeavours. His penchant for balloon travel has seen him get into a few scrapes, but his frequent world-record attempts have seen him become the first man to fly over Mount Everest. Like Musk, however, Branson's current venture is set to take him even further still.



Having delivered cargo to the ISS, the booster lands successfully on the drone ship, Of Course I Still Love You

Branson and Musk are obsessed with space, and they are putting sizeable wedges of cash towards their respective ventures and ambitions. Branson has set up Virgin Galactic with the aim of encouraging passengers to stump up \$250,000 for the undoubted pleasure of coasting towards the edge of space in its VSS Unity spacecraft. Musk founded SpaceX, which ultimately plans to populate the Red Planet, allowing anyone who can muster \$200,000 the opportunity to embark on the potential one-way trip of a lifetime.

Yet it is here where the two men differ, and where their personal space race assumes a separate path - Musk's sights are set on the Red Planet, while Branson wants it all. "Elon is absolutely fixated on going to Mars, and I think it's his life mission," Branson says. "I am more interested in how we can use space to benefit the Earth, because the Earth is, in my opinion, extremely beautiful, and needs to be protected."

Like Musk, Branson has expressed interest in colonising the surface of the Red Planet - but he's willing to share with the CEO of SpaceX. "Mars is a big place. When we colonise Mars, Musk can have the west end, and we're gonna have the east end," he laughs. "There's room for us both." Speaking on resources for future settlers on Mars, Branson states: "I think there's plenty of frozen water, and those

things, so we'll share the water." Musk, for his part, has indeed long argued that we must colonise the Red Planet. Should we seek to stay on Earth forever, he believes, "there will be some eventual extinction event." A case of do or die, then.

Of course, the end of our own planet is unlikely to happen any time soon, which is perhaps why Virgin Galactic is, for the time being at least, more concerned with letting would-be passengers have a bit of fun (as opposed to SpaceX's aim of saving the human race). Branson's company - which was founded in 2004 - sent its first astronauts into what's officially outer space in 2018, and hopes that tourists will be rocketing skywards soon after, realising a dream which has so far been reserved of those hand-picked for their skills by the world's space agencies.

Should Branson's estimates come true, then it means the 700 or so people signed up for the ride so far (reportedly including the actors Tom Hanks and Angelina Jolie) will enjoy unbuckling and experiencing several minutes of weightlessness in space sooner rather than later. They will be able to see Earth from a far greater height than any aeroplane could take them and, given that space has only been explored by 560 or so people so far, it would be something of a breakthrough. As Virgin Galactic points out on its website, it is opening space

## "Elon is absolutely fixated on going to Mars, and I think it's his life mission"

**Richard Branson**

### Elon Musk

Net Worth: \$20.2 Billion

#### 1983 Early talent

Having taken an interest in computer programming in his earlier years, at the age of 12, Musk used his new-found skills to create a game called *Blastar*, which he sold to a magazine for \$500.

#### 1992-1995 Graduated from university

Musk began his studies at Queen's University in Kingston, Ontario, Canada where he spent two years before moving to the University of Pennsylvania. He has two degrees: one in physics and one in economics.

SPACEX

#### 2002-Present Founded SpaceX

Musk founded Space Exploration Technologies in a bid to slash the costs of launching spacecraft. Known as SpaceX, it works with NASA and aims to make travel to Mars affordable.

#### 1995-2002 Headed up PayPal

After founding Zip2, which licensed city guide software to newspapers, Musk set up the online banking company X.com. Following a merger it became PayPal, and Musk emerged as CEO.

PayPal

#### 2004-Present Involvement with Tesla Motors

Having invested heavily in Tesla, Musk became chairman of the board. Today he is CEO and Product Architect, presiding over what promises to be an electric car revolution.

#### 2016-Present Creates The Boring Company

Believing congestion is best relieved by sending traffic underground, The Boring Company's inexpensive tunnels tie in with Musk's concept of a hyperloop - transporting passengers in pressurised capsules in tubes.

THE BORING COMPANY

TESLA

"Failure is an option here. If things are not failing, you are not innovating enough"

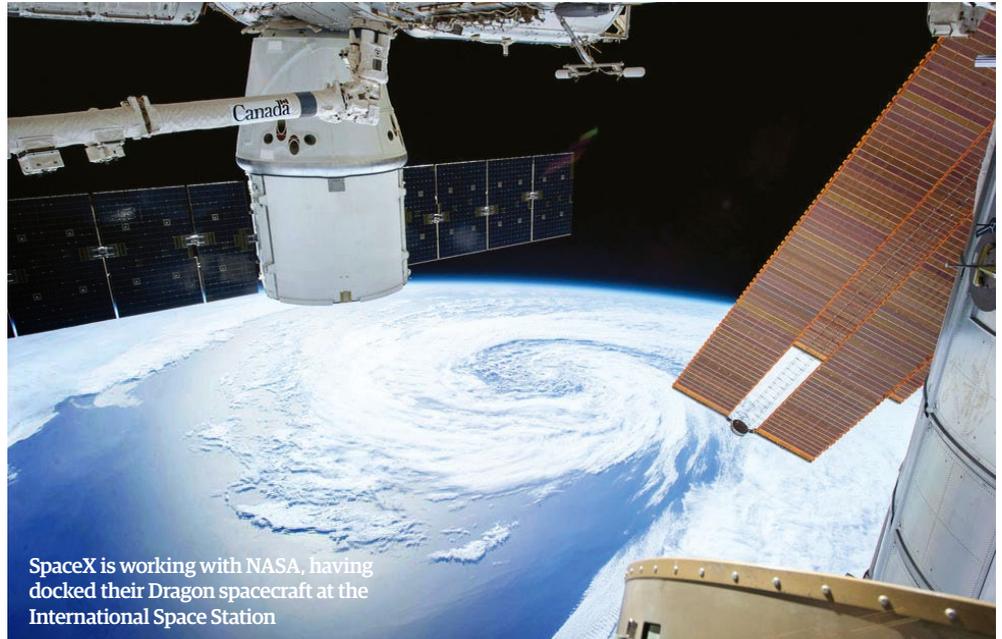
© Gregg DeGuire / Getty Images

to the rest of us (providing we have enough money). Musk is looking to do the same but on different terms: with Virgin you get to come back; with SpaceX, the journey to Mars is likely to be one way.

Professor Stephen Hawking was certainly excited about these developments. Branson offered the physicist a place aboard the Virgin Galactic spaceship, giving him the chance to fulfill his "ultimate ambition" of flying. Hawking, who chose the name Unity and whose eye was used as the model for the logo on the side of spacecraft, accepted the offer. "Since that day, I have never changed my mind," he told **All About Space**. Sadly he died before he could take it up.

Hawking, who shared the same views as Musk, claimed that we must look at colonising a new planet in the next 100 years, or suffer fatal future consequences. That was music to Musk's ears as he sought a band of space-faring pioneers to make the human race multi-planetary. "However, we will not establish self-sustaining colonies in space for at least the next hundred years, so we have to be very careful in this period," warned Hawking.

Musk wants to ferry people in a pressurised section of what he used to call the Mars Colonial Transporter but is now referred to as the Big Falcon Rocket, or BFR for short. Eventually, he hopes the journey time to the Red Planet will be just 30 days, but the idea is that the spacecraft would carry tons of cargo and building material and enable the colonisers to produce the necessary infrastructure and home comforts. "We'll have 450 tons of luggage and all of the unpressurised cargo to build everything from iron foundries, pizza joints, you name it," he says.



SpaceX is working with NASA, having docked their Dragon spacecraft at the International Space Station



Virgin Galactic's Spaceport America in New Mexico is the world's first purpose-built commercial spaceport



VSS Unity, built by The Spaceship Company, made its first free flight in December 2016, piloted by Mark Stucky and Dave Mackay

© SpaceX, Virgin Group Ltd

# Richard Branson

the world, they have the impressive CVs to match

**Richard Branson**  
Net Worth: \$5.1 Billion

**1966 Set up a magazine**

Although Branson struggled with school and dropped out at 16, his entrepreneurial flair was evident early on. In 1968, he launched *Student* magazine making money by selling advertisements.

**1986 Smashed a world record**

Branson crossed the Atlantic in a powerboat for more than three days, but completed the journey two hours faster than the previous record-holder. He has made many other record attempts since.

**1993 Received an honorary degree**

Having recognised his growing accomplishments, Loughborough University made him an honorary Doctor of Technology. In 2000, he was knighted by Charles, Prince of Wales for his 'services to entrepreneurship.'

**1970-Present Created Virgin**

After selling music by mail order, Branson opened his first record shop on Oxford Street in London, calling it Virgin because he was a beginner at business. A record label followed.



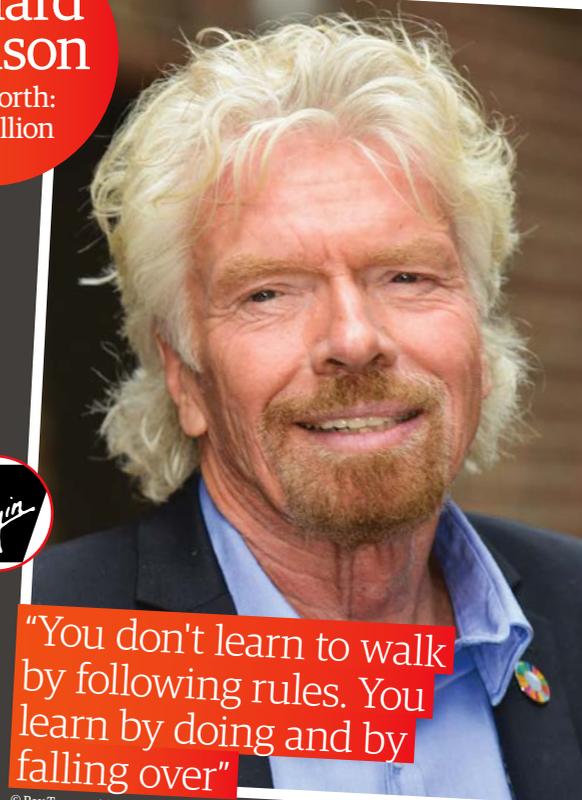
**1984-Present Launched Virgin Atlantic**

Branson became a thorn in British Airways' side when he launched a rival airline, Virgin Atlantic, quickly establishing itself by the decade's end.



**2004-Present Launched Virgin Galactic**

Not content with launching Virgin Trains in 1997, Branson went a step further and created Virgin Galactic, which aims to open up space travel to anyone able to stump up the cash.



© Ray Tamara / Getty Images

The Dragon is a reusable spacecraft developed by SpaceX. It's launched by the Falcon 9 rocket



Keen on conquering space, Branson hasn't let returning to the lunar surface escape his notice. "Why not have a hotel in space?" he asks. "How fantastic would it be to go and spend a week in a space hotel?"

With the two billionaires keeping their eyes locked on space, All About Space asked Musk whether he was thinking bigger than Branson. "He did name his firm Virgin Galactic. That's pretty big," Musk replied. "It's a bit like your name is Giant and you're actually quite small." He then added: "Technology is not really his whack you know."

Branson counteracted this claim and said he hoped to prove Musk wrong. He added that his own strength was surrounding himself with brilliant people (and indeed, in 2010, Virgin Galactic secured the services of George Whitesides, NASA's former chief of staff, as its chief executive). He also claimed his technology would eventually be able to transport passengers across the Earth in spaceships, and

## Virgin Orbit vs SpaceX

Branson and Musk also want to send private satellites into space on behalf of companies and governments

- Virgin Galactic began working on the LauncherOne concept in 2007.
- LauncherOne has a target price of \$10 million per flight.
- It can carry up to 300 kilograms (661 pounds) into Sun-synchronous orbits.
- It can also carry up to 500kg (1,100lbs) into a low-Earth orbit.
- After 16 months of modification work, 747-400 was complete.

**2 Beginning its ascent**  
As the rocket ascends into space, the two stages are separated. The first stage, which incorporates nine Merlin engines, can begin preparing to come back to Earth.

**3 Releasing the rocket**  
LauncherOne is then released, at which point it fires the NewtonThree - a single main stage engine - for three minutes. It produces about 327 kilonewtons (73,500 pounds) of thrust.

### 1 Launching from the ground

SpaceX's launches take place straight from the ground, so here we see the Falcon 9 medium-lift launch vehicle - the world's first partially useable launch system - being prepared for take-off.

### 1 Mounting the rocket

Virgin Orbit intends to piggyback rockets on Boeing jets; this allows better payload capacity and more flexibility than conventional rocket launches. The LauncherOne rocket is mounted beneath the left wing.

### 2 Taking off

The Boeing 747-400 - nicknamed Cosmic Girl - takes off with its payload and reaches an altitude of approximately 10,668 metres (35,000 feet).

Virgin Orbit  
SpaceX

put thousands of small satellites into space: two of the ways Branson says his company's missions will benefit people intent on remaining on this planet. Perhaps more interesting is the notion discussed on Virgin Galactic's website that "space is not only important for the future of transportation, commerce and science; it's also important for the future of imagination." This is where a line may be drawn between the aims of Virgin Galactic and that of SpaceX in this very modern space race.

Whereas Musk wants to save humankind by physically transporting as many as a million people to Mars on a total of 10,000 trips over the course of 40 and 100 years (the capacity of the spacecraft

is 100). Branson wants to do the same by altering mental attitudes. He talks of the Overview Effect, felt by astronauts when they go into space: "Having left the Earth and seen it from thousands of miles away, they gain new perspective on their home planet, and see how tiny the differences are and how great the shared bonds," he writes. "They return with a profound desire to change the world for the better."

Musk appears to think differently. He feels that humans on Earth will only strive to resolve the problems they have created when they realise the mess they're in is real. In that sense, he isn't overly concerned about shaping minds right now, believing it will happen naturally and in due course. "The

sustainable energy future, I think, is largely inevitable, but being a space-faring civilisation is definitely not inevitable," he says. Attempting to save humans, wherever they may end up, is more of a priority than purely trying to make Earth alone better, it seems.

Even so, both Musk and Branson are interested in bettering lives through faster transport, which is why they are also locked in a side-battle over hyperloop technology. The brainchild of Musk, hyperloop involves whizzing passengers from A to B on Earth in pressurised capsules. However, while the chief of SpaceX's The Boring Company seeks to build hyperloop tunnels underground, Hyperloop One, in which Branson has invested, prefers tunnels to be overground. Different approaches and different mindsets appear to be at play at every step.

Given their interests overlap, the main question is why they haven't sought to work together? That may go back to 2015, when Branson teamed up with Alphabet CEO Larry Page to develop a space-based

"He did name his firm Virgin Galactic. It's a bit like your name is Giant and you're actually quite small" **Elon Musk**

## 4 Shipping the satellite

Now a single upper-stage engine - the NewtonFour - kicks in. It has 22 kilonewtons (5,000 pounds) of thrust, using RP-1 kerosene and liquid oxygen for fuel. This carries the satellite into orbit.

## 5 Releasing the payload

After executing multiple burns for around six minutes, LauncherOne deploys the satellite into its orbit. Its job is now done, allowing the two LauncherOne stages to be deorbited and the plane to land at a predetermined airport.

- SpaceX began working on Falcon 9 in 2006.
- It can launch a payload for a minimum of \$62m, according to its website.
- Falcon 9 is capable of carrying 8,300 kilograms (18,300lbs) into geostationary transfer orbit.
- It can also carry 22,800 kilograms (50,265lbs) to low-Earth orbit.
- Falcon 9 made history by delivering the Dragon Spacecraft into orbit to the ISS in 2012.

## 4 Sending the payload into orbit

The payload fairing - the nose cone that protects the spacecraft - separates, followed by the payload itself. The satellite is now in orbit and SpaceX's job is done.

## 5 Coming back down

The first stage is slowed by the engines while the grid fins steer the lift. The idea is to get it to land safely and vertically on a drone ship so that it can be used again and again.

## 3 Flipping it round

The first stage is flipped by cold-gas thrusters and the engines fire up to alter the trajectory so that it moves towards the landing site. Hypersonic grid fins manipulate the direction of its lift during re-entry.

# "Mars belongs to Elon"

How Elon Musk is planning to create a Red Planet colony

## 1. Build a really big rocket

SpaceX is creating the Big Falcon Rocket (BFR) - a rocket larger than any that have gone before. Weighing a total of 4,400 tons at liftoff, and standing at 106 metres (347ft) tall and nine metres (30ft) in diameter, it will have a liftoff thrust of 5,400 tons. It will also have 31 Raptor engines and be fully reusable, helping to dramatically reduce costs. SpaceX hopes to have it ready for use in the early 2020s.



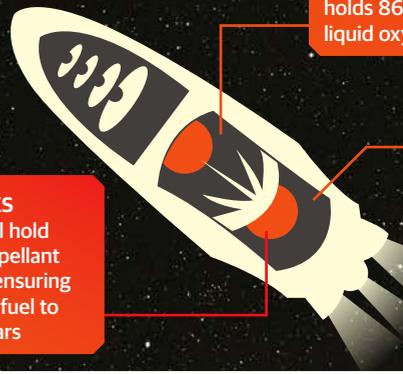
**Oxygen tank**  
Separated from the methane is a tank that holds 860 tons of liquid oxygen

**Header tanks**  
This section will hold the landing propellant during transit, ensuring there's enough fuel to get safely to Mars

**Fuel tank**  
The fuel tank will hold 240 tons of methane at the bottom of the spacecraft, just above the engines

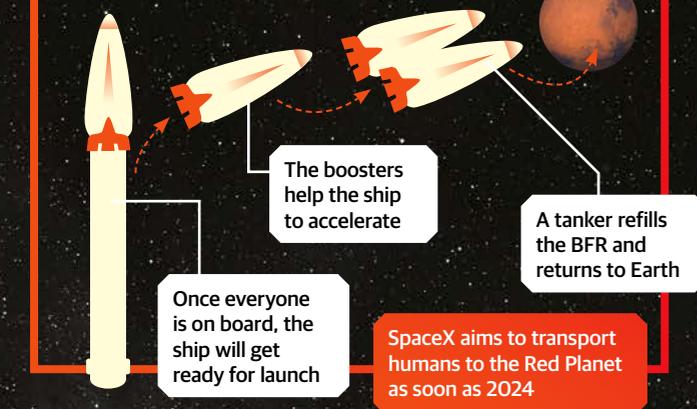
## 2 Create a humongous spaceship

At the tip of the BFR is the payload: the section where passengers will stay and where the cargo will be stored. It will have 40 cabins and large common areas along with a galley and a solar storm shelter, plus lots of entertainment: it's a long journey after all. SpaceX says the cabin will be pressurised to a volume of 825m<sup>3</sup>, which is greater than that of an A380 aeroplane. It's thought 100 people will complete each journey.



## 3. Get it into space

The BFR will take off vertically, propelled skywards by its 31 engines. When it gets through the Earth's atmosphere, the booster will detach and power back to Earth. The spaceship will then continue on its way, making use of the fuel tank that holds 240 tons of methane and the oxygen tank that holds 860 tons of liquid oxygen. There are six Raptor (two types) engines on the spacecraft itself.



The boosters help the ship to accelerate

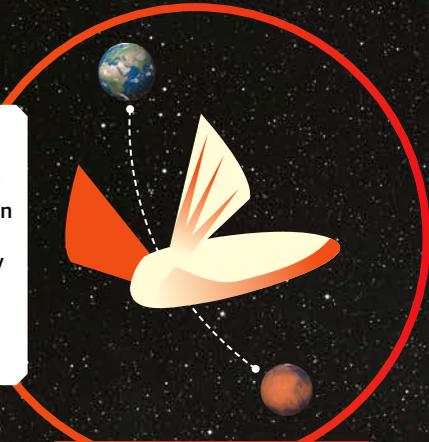
A tanker refills the BFR and returns to Earth

Once everyone is on board, the ship will get ready for launch

SpaceX aims to transport humans to the Red Planet as soon as 2024

## 4. Make the long journey

Cries of "are we nearly there yet?" are inevitable, because the journey to Mars will take anywhere between three and six months. Solar panels will be deployed during the journey and this will power some of the much-needed entertainment. The views should be spectacular as the Red Planet looms into view.



The BFR will make use of advanced heat-shield technology

## 5. Ensure a safe landing

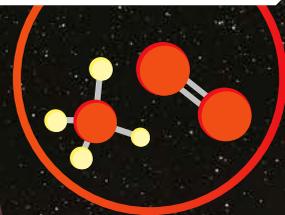
When it gets to Mars, the spaceship's legs will deploy for a vertical landing, but it's fair to say touching down on the surface will be no simple feat. The aim, says Musk, is to make it as safe as landing a commercial plane, so although it will land under the retro-propulsive thrust of two Raptor engines, it could also do it with one if there was an engine failure. Time for the passengers to disembark.



The idea is that the founding Martians will be able to enjoy the spoils of a new galactic city

## 6. Get it back to Earth

Since the spaceship is reusable and there is potential that some people may want to come back to Earth, the spacecraft needs to take off from Mars and return. The idea is to use the Red Planet's abundant supply of CO<sub>2</sub> and water ice to locally produce CH<sub>4</sub> and O<sub>2</sub> propellant. Once it arrives on Earth, it will be checked over and placed on a BFR again, ready for the next group of Mars-bound passengers.



internet that would use inexpensive, low-power satellites for launch by Virgin Galactic. It appears that Branson wanted Musk on board, but "was saddened that Elon didn't consider working with Larry and me."

Instead, SpaceX and Virgin Galactic are charting their own separate paths, and they are both proving to be successful. In October 2017, Virgin Galactic was given a boost thanks to \$1 billion in funding from Saudi Arabia, authorised by its new Crown Prince Mohammed bin Salman. "This will enable us to develop the next generation of satellite launches and accelerate our programme for point-to-point supersonic space travel," Branson says. This is, in some sense, another sub-race, because SpaceX is also hoping its rockets will enable point-to-point Earth travel too. Musk has suggested future passengers could wing their way from New York to Shanghai in as little as 39 minutes at over 18,000 kilometres-per-hour (11,372 miles-per-hour).

Branson is also looking to go toe-to-toe with SpaceX in bagging commercial and government

contracts. He is doing so with a new space-centred company called Vox Space, based in southern California. Its aim, according to its website, is to "provide the national security community of the USA and allied nations with the ability to launch services for small satellites bound for low-Earth orbit". Another spin off, Virgin Orbit, will also launch services for small satellites, but those government contracts are a lucrative business. SpaceX offers rockets capable of carrying 22,680-kilograms (50,000 pounds) to low-Earth orbit, compared to the 181-kilograms (400-pound) capacity of Vox. It is also designing a spacecraft for NASA.

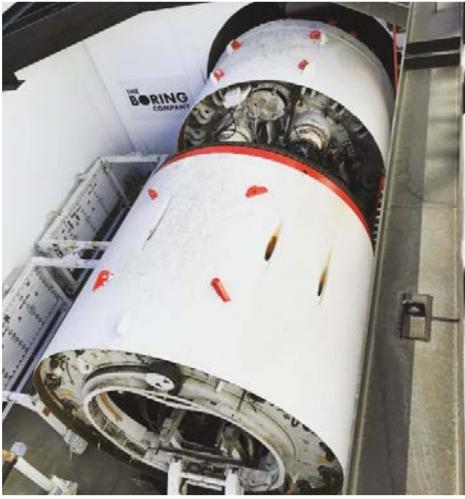
While Virgin Galactic and SpaceX are not competing with each other to be the first to Mars, they are going head-to-head in other areas. So, while, SpaceX isn't planning on launching its first mission to Mars before 2022 (a timescale even Musk readily admits is "aspirational"), their other plans should come to fruition sooner. Branson is set to win the personal space race, however, since he is very much on course to be the first of the pair to journey into space.

He is certainly keeping himself fit and active so that he can make the journey, even though he admits that the Virgin Galactic project has been one of his greatest challenges. It has already claimed the life of test pilot Michael Alsbury when the first version of the SpaceShipTwo disintegrated over the

Mojave Desert in 2014. Virgin Galactic has since received its operating license from the US Federal Aviation Authority, and Branson is also taking part in centrifuge training, which involves being spun to a high speed in order to simulate the feeling of gravity. His body is prepared for the likely strains of space travel.

Musk, on the other hand, is far less likely to be on his spacecraft to Mars in the early stages, although he does want to go eventually. "I'd have to have a really good succession plan [for SpaceX], because the likelihood of death is very high," he explains. He is understandably worried about not seeing his children grow up and he frets that investors may decide, in his absence, not to continue with the Mars plan. But he has said that he wants to die on Mars: "I can't think of anything more exciting than going out there among the stars," he smiles.

One thing's for sure, though, these are fascinating times for both Musk and Branson, and it's heartening to see that the pair are so passionate about space and it's exploration. The levels of investment in their respective endeavours truly brings them together, and there's no suggestion that a bit of healthy competition is a bad thing. With so many clever scientists and engineers working on the various projects, and two driven bosses, we will inevitably reach new heights. The future is indeed looking bright.



## "I can't think of anything more exciting than going out there among the stars"

**Elon Musk**

Hyperloop technology was originally an idea coined by Musk, with Branson investing in the American company Hyperloop One in 2017

