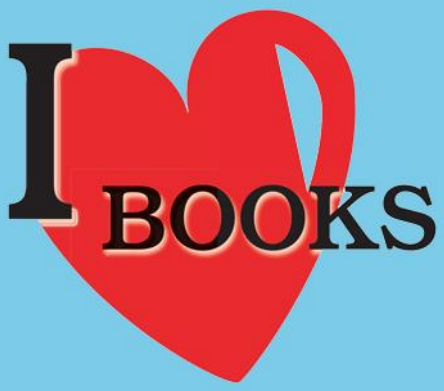


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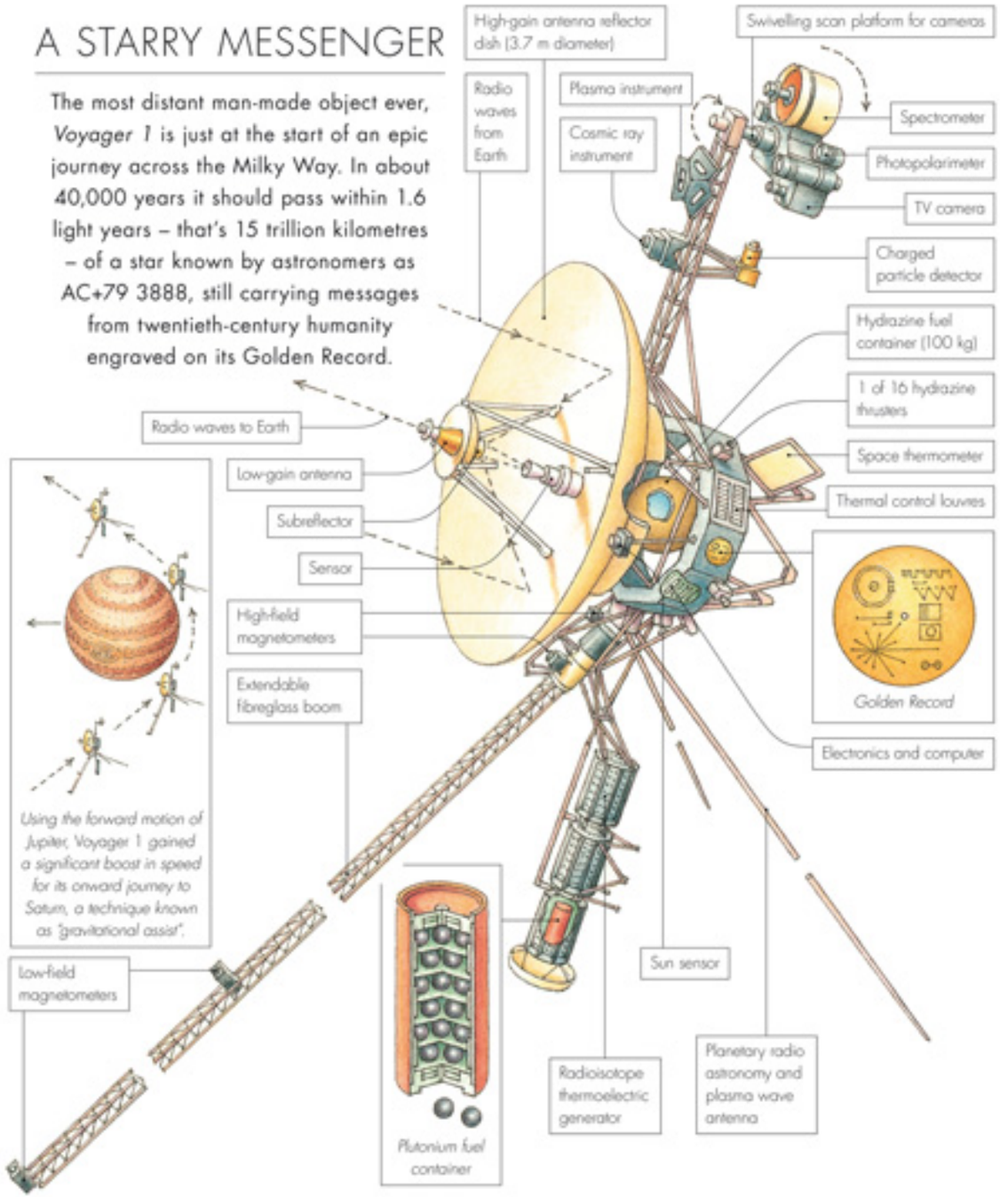
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A STARRY MESSENGER

The most distant man-made object ever, *Voyager 1* is just at the start of an epic journey across the Milky Way. In about 40,000 years it should pass within 1.6 light years – that's 15 trillion kilometres – of a star known by astronomers as AC+79 3888, still carrying messages from twentieth-century humanity engraved on its Golden Record.



The presence of the record was a hint that this was no ordinary rocket launch. In fact it was to be the start of the most epic voyage yet undertaken from planet Earth. Just under 35 years later, still operating and still sending information back to Earth, the spacecraft – *Voyager 1* – crossed an invisible boundary known as the heliopause and passed into interstellar space, leaving the known planets of the solar system far behind. The distance it had covered to do this is mind-boggling – 18 billion kilometres, over 120 times as far as the earth to the sun.

Voyager 1's journey has been more successful than anyone dared hope. Its original mission was to help explore the mysterious giant planets whose orbits lay far out in the solar system. In the 1960s, scientists had worked out that during the 1970s all four of these – Jupiter, Saturn, Uranus and Neptune – would be lined up in such a way that a spacecraft would be able to pass by them all in turn, using a special technique called "gravitational assist".

This was a rare opportunity, as the planets would not line up in the same way for another 175 years. The US National Aeronautics and Space Administration (NASA), who were behind the project, had at first wanted to send several space probes out to take advantage of this, but that turned out to be too expensive. In the end NASA did manage to persuade the government to provide enough money for two probes, rather than just one, although the missions planned for each were different. *Voyager 2* would try to visit all four large planets. *Voyager 1*, its identical twin but travelling on a more direct course, would just visit Jupiter and Saturn.

Confusingly, *Voyager 2* took off first, on 20 August, but by the end of the year *Voyager 1* had overtaken it. For the next fifteen months it zipped through space heading directly for Jupiter, the largest planet in the solar system. In March 1979, it flew to within 207,000 km of the giant's surface, before plunging even deeper into space on its way to Saturn. It reached there in November 1980, flying past a number of Saturn's many moons, all the while sending photographs and information from its sensors back to Earth. Its main mission successfully completed, *Voyager 1* continued on its journey. Its role now was to explore the outer reaches of the solar system for as long as its power supply lasted and its instruments went on working.

Some nine months after *Voyager 1* had visited Saturn, *Voyager 2* arrived there, on its way to the even more distant Uranus and Neptune. It took another four and a half years to reach Uranus, and another three and a half after that to get to Neptune. Then it too went on its way, heading away from the sun in a different direction from *Voyager 1*.

It's hard to say when exactly the Voyagers or any of the other three spacecraft currently on track to leave the solar system (*Pioneers 10* and *11*, launched in the early 1970s, and *New Horizons*, launched in 2006) will have left it completely behind. That's because we can't really say exactly where the solar system ends. The heliopause is one kind of edge, but the sun's gravity goes on having an effect much further away than that. Astronomers are pretty sure that way, way beyond the heliopause is a region called the Öpik–Oort cloud, where billions of objects, some many kilometres across, are endlessly circling the sun, in the same way as our own planet but in hugely bigger orbits. The edge of this cloud can be thought of as another kind of edge of the solar system. Even speeding along at 60,000 kph, *Voyager 1* will take about 30,000 years to reach there. By then it will long ago have stopped working – after around 2025 its batteries will not be strong enough to power any of its instruments – but there's no reason why it should not still be intact and still travelling on its solitary journey through the outer reaches of the galaxy we call the Milky Way.

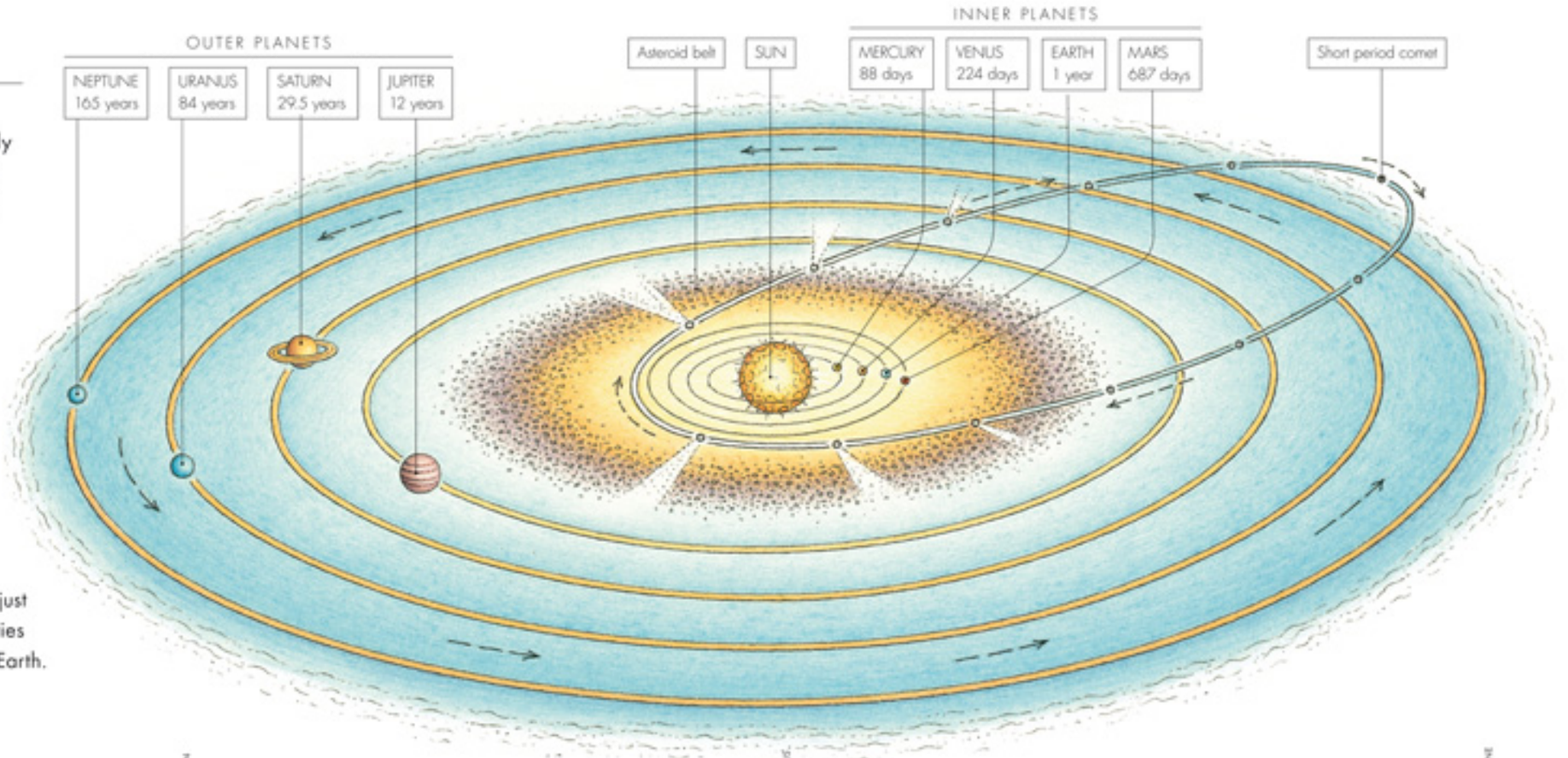
It's an amazing thought: less than 100 years after the invention of the motor car, we humans have built and launched vehicles that can leave the solar system. Not only that, we've landed space probes on two planets, two moons and a comet and visited one of those moons – the earth's own – in person, not once, but six times. No wonder people call this the "space age".

OUR OWN BACKYARD

The solar system is quite a busy place. Eight planets, including Earth, orbit the sun in slightly stretched circles called ellipses, each taking a different length of time – from 88 days to 165 years – to make one circuit.

Much else goes round the sun: asteroids, some of them hundreds of kilometres across, concentrated in a belt between Mars and Jupiter; comets on highly eccentric orbits, swooping in from the outer reaches of the solar system and then heading out again; and, just beyond Neptune, the Kuiper Belt, containing Pluto and other dwarf planets.

All the planets, except Mercury and Venus, have their own natural satellites – moons and moonlets that in turn orbit them. The earth has just one; Mars two; Saturn dozens, as well as a series of spectacular icy rings that can be seen from Earth.

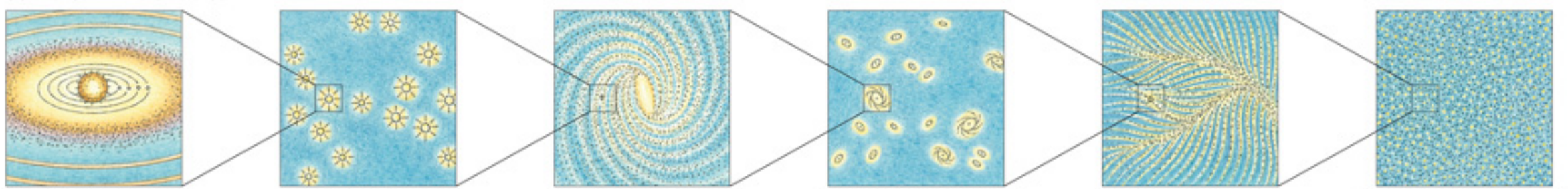


THE SOLAR SYSTEM TO SCALE



One astronomical unit is 150,000,000 km, the average distance between the earth and the sun.

OUR PLACE IN THE UNIVERSE



The sun at the centre of our solar system is one of a few dozen stars in …

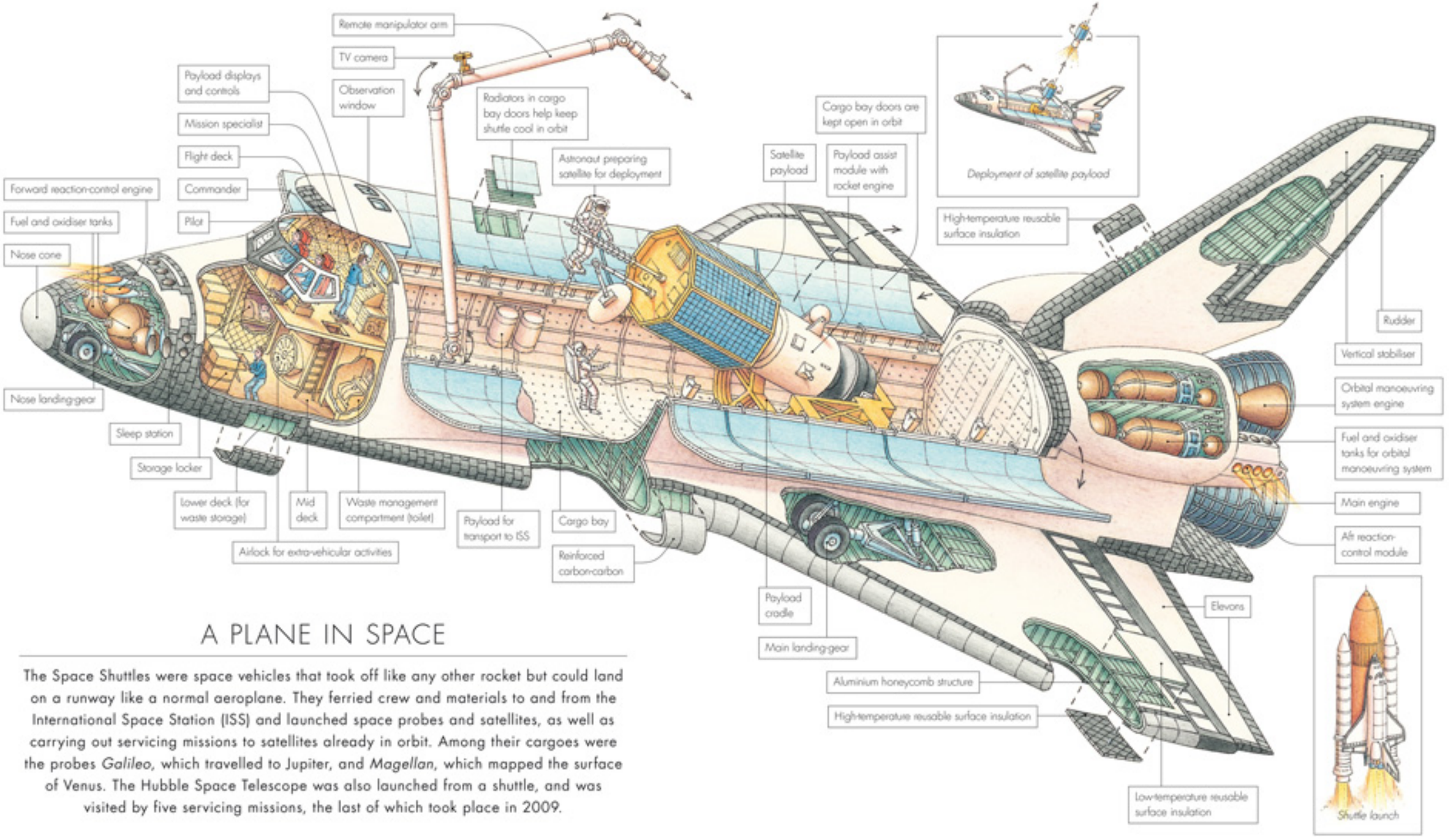
our local interstellar neighbourhood, which forms a tiny part of …

a spiral arm called the Orion arm of the Milky Way galaxy, which is one of …

a few dozen galaxies in our local group of galaxies, which is part of …

a supercluster called Laniakea, which contains about 100,000 galaxies …

which is less than a millionth of the number of galaxies in the known universe.



A PLANE IN SPACE

The Space Shuttles were space vehicles that took off like any other rocket but could land on a runway like a normal aeroplane. They ferried crew and materials to and from the International Space Station (ISS) and launched space probes and satellites, as well as carrying out servicing missions to satellites already in orbit. Among their cargoes were the probes *Galileo*, which travelled to Jupiter, and *Magellan*, which mapped the surface of Venus. The Hubble Space Telescope was also launched from a shuttle, and was visited by five servicing missions, the last of which took place in 2009.