NEW

MIRACLE MACHINES OF MEDICINE

WORLD OF TOMORROW

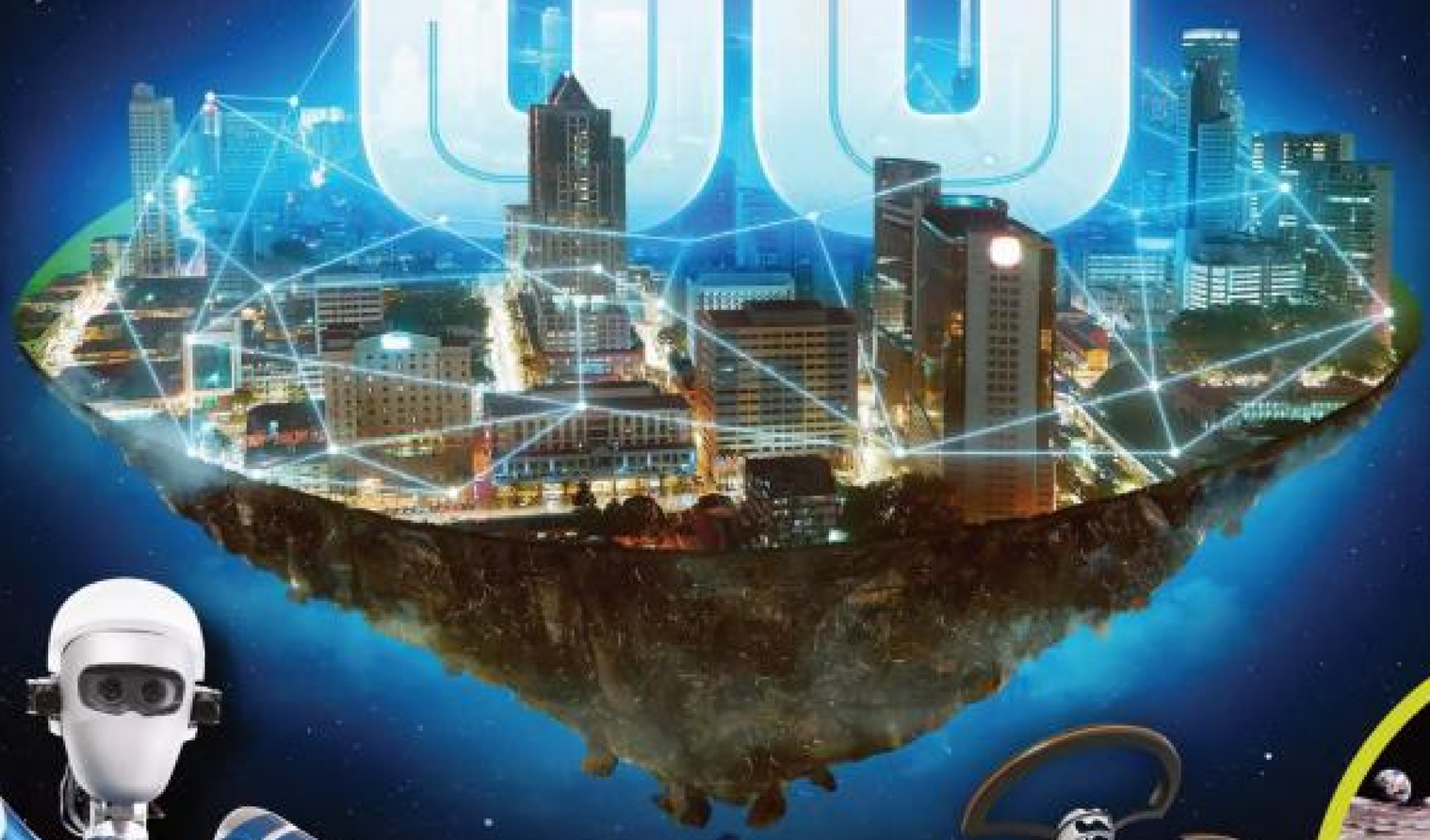
ANATOMY OF A JETPACK

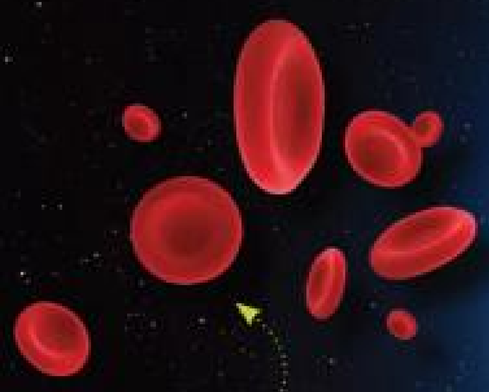
Everything you need to know about the future

HYPERSONIC PLANES

HIGH-TECH HOLIDAYS

5G





HACKING THE HUMAN BODY

CAN WE CURE CANCER?

HOW IT WORKS

REMOTE-CONTROLLED SPACE EXPLORERS

DRONE DELIVERIES

COLONISING THE MOON

Digital Edition

FUTURE

FIFTH EDITION

NEXT-GEN TRANSPORT • NANOTECH • SPACE TRAVEL

WELCOME TO

HOW IT WORKS

WORLD OF TOMORROW

Do you ever wish you had a crystal ball so you could take a peek at what is to come in the distant future? Well, now you can, with this new edition of How It Works World of Tomorrow! While it's no magical artefact, it does offer a glimpse of future developments in transport, medicine, entertainment and space travel based on the innovations taking place in the present day, and speculations made by scientists and engineers. Learn more about how humans will live, interact and better the planet we live on (as well as other planets) in the future. You can expect flying cars, moon colonies and bionic limbs, but you'll also discover whether you will be able to 3D print a customisable pizza, how technology will change our shopping experiences in the next 50 years and how we might cure big killers like cancer . . . Whether you want to know if we'll leave our roads and pavements behind, or whether we'll ever be able to take holidays to other planets, you will find the answer in this book. No crystal ball required.

WORLD OF TOMORROW

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bookazine series

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INSIDE THE WORLD OF TOMORROW

Experience the lean, green cities we'll soon be living in

Major cities are often viewed as grey, energy-guzzling monoliths, but the cities of the future could change everything. As the planet's store of fossil fuels dries up, we are looking for new ways to power our cities in sustainable but spectacular-looking ways.

Skyscrapers will become towering greenhouses as vertical farming takes hold. Crops would be grown between storeys, taking advantage of the Sun's energy while using minimal ground space. These ecological super-buildings would have photovoltaic solar-cell facades and be topped by wind turbines, making these homes the ultimate self-sustaining structures.

Tomorrow's city centres could look very different as groups gather below solar powered trees. These so-called eTrees offer more than just shade, as the energy produced from the solar panels transforms them into mobile phone charging stations, free Wi-Fi and night lighting. The solar energy also activates an LCD screen that displays information such as the weather and educational content.

Building upward would allow plenty of room on the ground for urban social areas as well as luminous plants. These are implanted with light-giving compounds known as luciferins, which will make the greenery glow at night as a cost-effective and eco-friendly method of illuminating tomorrow's cities.

Far from being a scary, soulless world as shown in movies like *Judge Dredd* and *Blade Runner*, the future cities promise to be bright, spacious and green, making the most of the amazing natural resources we have at our disposal already.

eTrees
Trees with solar panels instead of leaves can provide charging stations for phones and free lighting.

Energy storage
Excess energy produced by solar panels and wind farms would be stored in batteries and fed back into the national grid.

Plants replace street lamps
Researchers at the Glowing Plant project have transferred firefly genes into plants to make them glow in the dark and light your way home.

Virtual fitting rooms
This tech is already here! Some stores offer you the chance to superimpose clothes onto your body using a tablet or smartphone app.

© Science Photo Library; Getty; Corbis; Dreamstime

TOMORROW'S TRANSPORT

Why getting from A to B will soon become a breeze

When you hear the term 'transport of the future' your mind will generally turn to flying cars. Excitingly, they're already on their way. AeroMobil has unveiled the third version of its flying vehicle. Capable of switching in seconds between car and plane, you could wing your way to your destination, free from traffic jams and roadworks. On the ground, the AeroMobil uses regular petrol and fits into any standard parking space, but can reach 200 kilometres (124 miles) per hour in the air thanks to its Rotax 912 engine. This would reduce the traffic in future cities, making the streets safer for people on the ground.

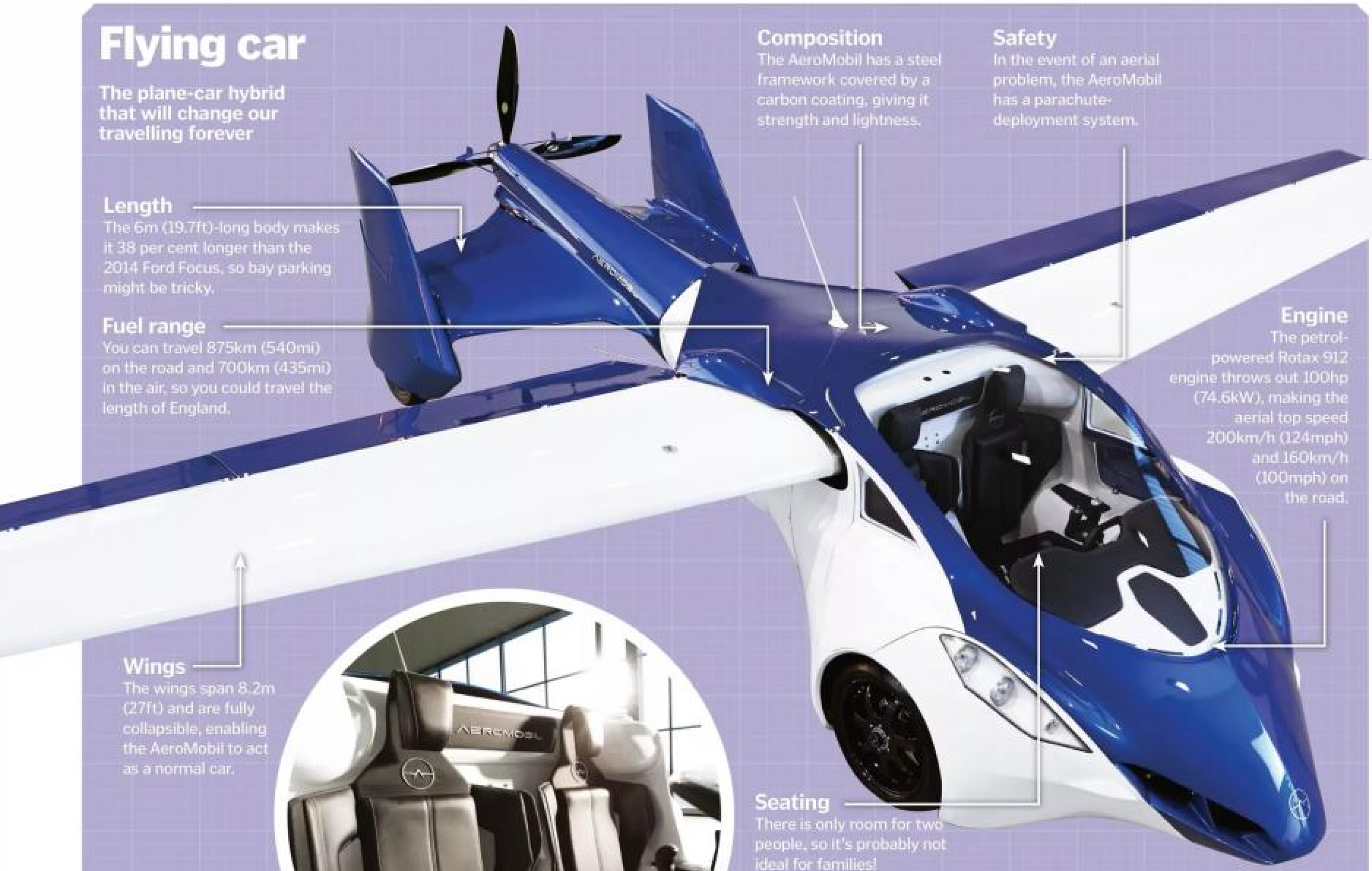
Also, companies such as Amazon and DHL are trialling drones that can deliver parcels under 2.3 kilograms (five pounds), which Amazon says makes up 86 per cent of their deliveries. The use of drones will clear the streets and air as they will be battery or solar powered.

If you still felt like you wanted to stay on the ground, however, driverless taxis could ferry you around. The Google driverless car has already completed over 1,125,000 kilometres (700,000 miles) of accident-free driving using GPS satellites to map routes and on-board cameras to search for hazards.

These cars could be used as taxis – which would be summoned by a smartphone app – and would drive closer to each other and more efficiently than human drivers, meaning that no one need ever own a car. Unless it's an amazing flying car, that is.

Flying car

The plane-car hybrid that will change our travelling forever



Length
The 6m (19.7ft)-long body makes it 38 per cent longer than the 2014 Ford Focus, so bay parking might be tricky.

Fuel range
You can travel 875km (540mi) on the road and 700km (435mi) in the air, so you could travel the length of England.

Composition
The AeroMobil has a steel framework covered by a carbon coating, giving it strength and lightness.

Safety
In the event of an aerial problem, the AeroMobil has a parachute-deployment system.

Engine
The petrol-powered Rotax 912 engine throws out 100hp (74.6kW), making the aerial top speed 200km/h (124mph) and 160km/h (100mph) on the road.

Wings
The wings span 8.2m (27ft) and are fully collapsible, enabling the AeroMobil to act as a normal car.

Seating
There is only room for two people, so it's probably not ideal for families!

The AeroMobil's dashboard is a little more complicated than today's cars'

TheAeroMobil's road version looks fittingly futuristic and sleek

Delivery drones

At the moment delivery companies spend huge sums of money and use enormous amounts of fuel on delivering parcels, but in the city of the future drones could take on the task. Amazon and DHL are testing out drones that could deliver the majority of their products. These autonomous flying vehicles are lightweight and can be pre-programmed to reach their destination, guided by satellites.

They could deliver to hard-to-reach areas such as islands and take a huge number of vehicles off the roads. As they are powered either by batteries or solar power, they wouldn't be a drain on resources like delivery trucks either.

At the moment it is still illegal in the US for Amazon to use their drones for commercial reasons, although the company is in talks with the FAA to work around this. As the technology is already there it is looking increasingly likely that these devices could be in our skies within the next few years.

Kick back and let the car of the future drive you around

Driverless taxis

There is a very good chance that in the future, no one need ever own a car. Just like London and New York's bike-rental scheme, driverless cars could be summoned to your house and drive you to work. As they will drive themselves with much quicker reactions than humans and can't be distracted, they will be able to run at a steady speed, closer together and with fewer accidents, removing the main causes of traffic jams. Rooftop cameras will use lasers to scan the road ahead at a range beyond that of human vision. A second camera will look to the sides for hazards like pedestrians or animals. The guidance system will use GPS, altimeters and gyroscopes to keep track of where it is and where it is going. As 90 per cent of a car's life is spent parked, autonomous hire cars could become the most efficient way to get around.

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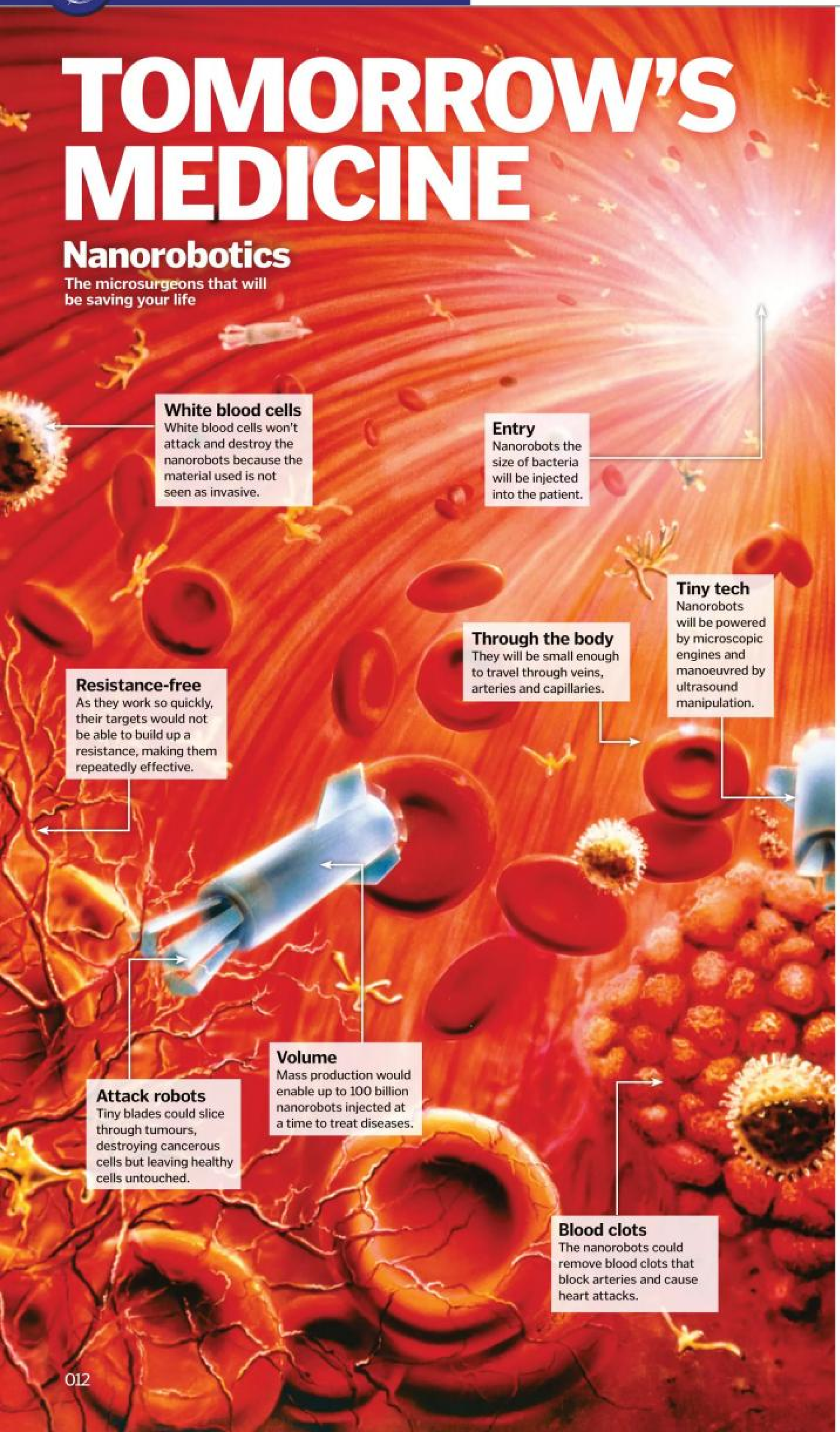
TOMORROW'S MEDICINE

Nanorobotics

The microsurgeons that will be saving your life



The microscopic tech that saves your life from within

The area of nanomedicine is one that is advancing so rapidly that doctors could soon be piloting miniature robots through your body to diagnose and even battle illness. It is expected that within 20 years, molecular manufacturing will have reduced the size of robots to roughly the size of bacteria, meaning they can enter the body to spot and even cure disease.

The miniscule robots could be programmed to behave like a white blood cell, seeking out illness-causing bacteria or germs, latching onto them and slicing them up into molecules too small to do any further damage. Doctors could then remove the robots by using an ultrasound signal to direct the robots toward the kidneys where they would get washed out in urine.

Another potential use for nanorobots in medicine is actual surgery. A set of chromosomes would be manufactured outside the body and attached to a nanorobot. This would head straight toward a diseased cell, remove the damaged chromosomes and replace them with the healthy ones.

Another fascinating area of study is anti-ageing. Researchers have managed to restore the health of cells in a two-year-old mouse making it as fit as a six-month-old mouse. By injecting nicotinamide adenine dinucleotide (NAD) into the mice, scientists increased the level of communication between cells. This is very important, as a lack of communication between cells is heavily linked to diabetes, dementia and cancer. It's hoped that this scientific breakthrough will ultimately be proven successful in humans.

TOMORROW'S ENERGY

Fusion power: clean energy for tomorrow's power stations

Nuclear fusion is an incredibly exciting new direction that could provide Earth with huge amounts of clean energy. In nuclear fusion, helium nuclei are forced together to create a new atomic nucleus. The atomic mass of the two nuclei is greater than the mass of the resulting nucleus, so the extra mass is given off as energy. This can be harvested for practical uses.

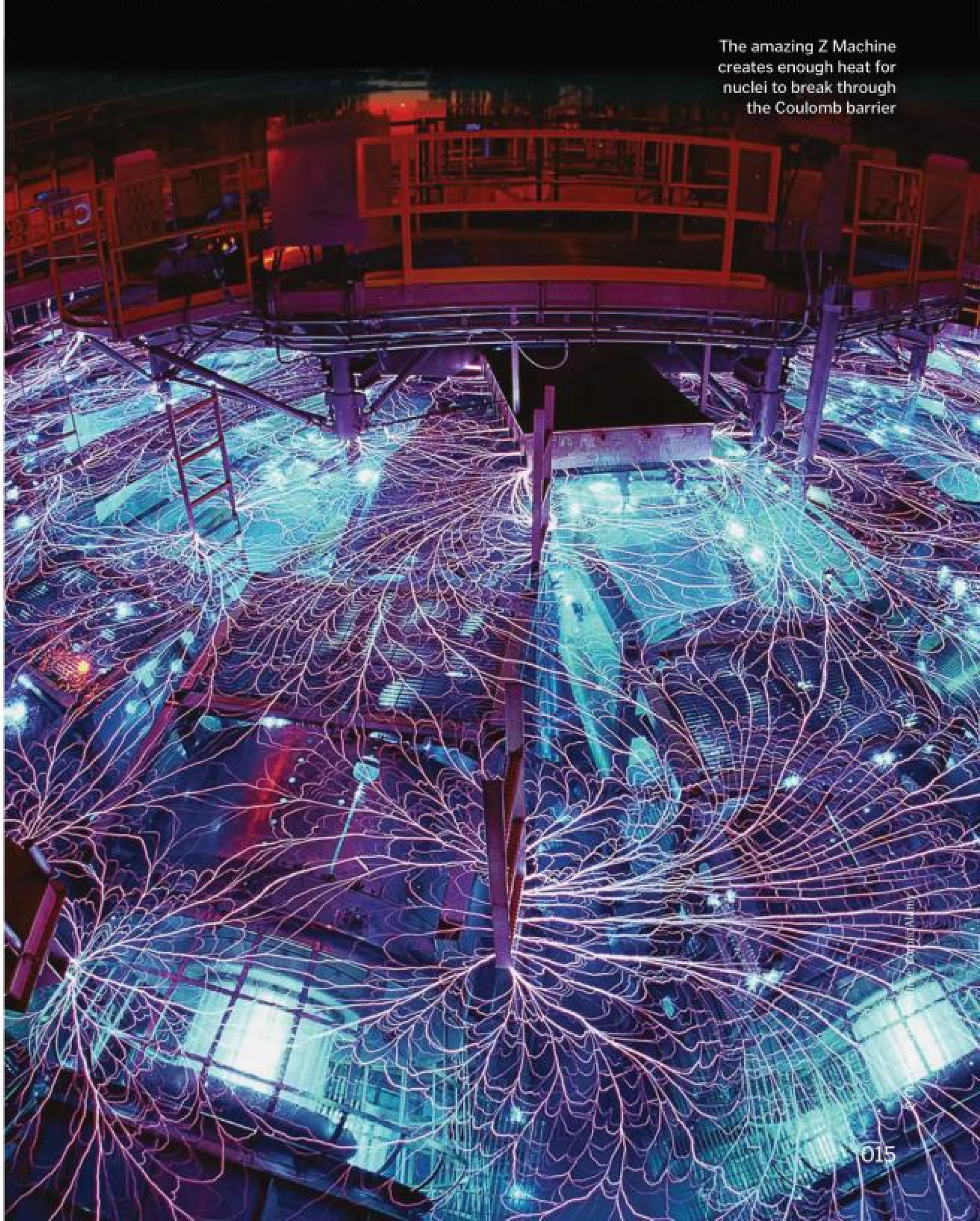
The main barrier to nuclear fusion is temperature. Nucleons are held together by strong forces, while an electromagnetic force tries to pry them apart. When protons come into close contact, the electromagnetic force pushes them apart in what is called the Coulomb barrier. 40 million degrees Celsius (72 million degrees Fahrenheit) of heat is needed to break through the Coulomb barrier and allow the nuclei to fuse. This extreme heat could be provided by the Z Machine produced by Sandia National Laboratories, USA. This machine uses electricity to create radiation that heats the walls of the facility to nearly 2 billion degrees Celsius (3.6 billion degrees Fahrenheit).

Calorie counter
So far today you have walked 8.2km in two hours. This has burned 495 calories.

Weather
The current temperature is 18°C (64°F) and sunny. There is a ten per cent chance of rain.

Entertainment
Turn to your right to buy tickets for a range of Broadway shows including *Book Of Mormon* and *Matilda*.

Location
There are three of your Facebook friends within 1km (0.62mi). Connect with them?



The amazing Z Machine creates enough heat for nuclei to break through the Coulomb barrier

COLONISING MARS

The tech that will help us go where no man has gone before

Ever since Neil Armstrong set foot on the Moon, there have been dreams to colonise other bodies in the Solar System, something that is becoming increasingly viable thanks to advancements in space travel and space suits.

Voyager 1 has travelled just short of 20 billion kilometres (12.4 billion miles) from planet Earth, but so far, humans have only reached the Moon, which is 384,400 kilometres (239,000 miles) away. The main reasons behind the difficulty of sending humans further distances are fuel storage, costs and the comfort of the astronauts. At least one of these conditions has to be compromised for a long-distance journey into space and that has held us back.

The reaction between nano-aluminium powder and water creates a powerful blast of hydrogen gas and aluminium oxide. This provides the thrust for a rocket to launch without weighing too much. Solar technology, will also reduce the reliance on fuel, lightening the load.

MIT has developed a skintight space suit that essentially shrink-wraps the astronaut, providing counter-pressure to the atmosphere. This will be much lighter and more flexible than current space suits, making extended periods of wear much more bearable.

3D printing has paved the way for missions in space to be much more streamlined. The ability to design and print almost anything from a tiny bolt to a huge satellite dish means that missions can leave without bulky payloads on board.

All these advances in technology have pushed forward the possibility of inhabiting another planet. Mars One is a now-defunct project that optimistically aimed to have humans living on Mars by 2025. They hoped to achieve this by sending up rovers and life-support units, which would have sought out a location close enough to the poles for water, the equator for solar power and flat enough to build on. The life-support units would have leeched water from the soil by heating subsurface ice. Some would've been stored and some used for oxygen, nitrogen and argon, to make the atmosphere breathable.

Reaching Mars

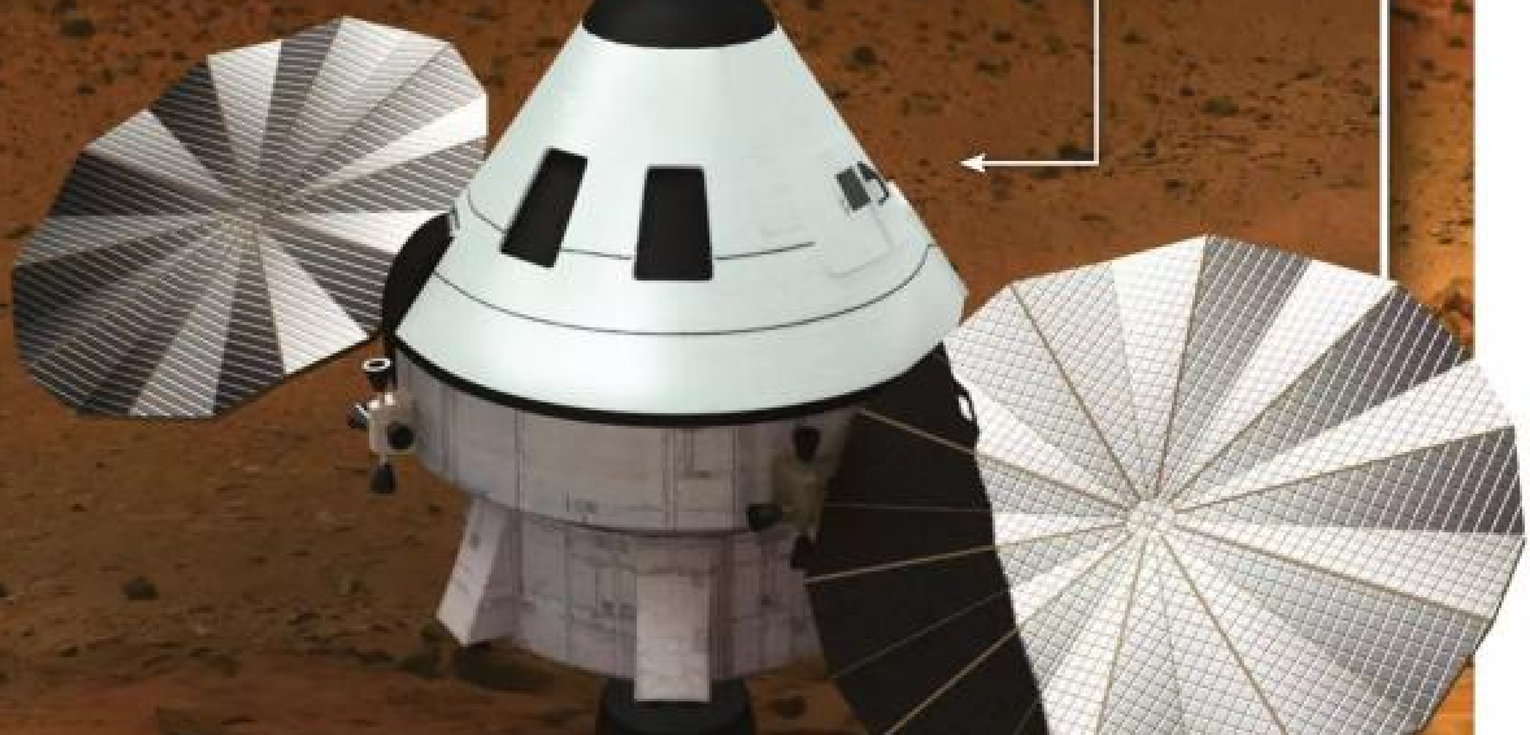
To make it to the Red Planet, new spaceships are needed – these are the best ones currently in development

Falcon 9
A two-stage reusable rocket that will take the spaceship to Mars. It is designed by private space company SpaceX.

Saturn V
King of the Apollo era, NASA's three-stage rocket successfully launched 13 times. A similar design, such as NASA's Space Launch System (SLS), could also take astronauts to Mars.

VASIMR
The Variable Specific Impulse Magnetoplasma Rocket converts gas into magnetised plasma, providing powerful fuel to shorten the journey.

Crew capsules
NASA's Orion Multipurpose Crew Vehicle or SpaceX's Dragon capsule could carry the colonists to Mars.



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5 TIMES THE SPEED OF SOUND

HYPERSONIC FLIGHT

Inside the planes that will smash supersonic records

BUILDING A HYPERSONIC VEHICLE

The challenges and successes in the engineering community's quest for hypersonic flight

Supersonic aircraft such as Concorde differed greatly from their subsonic counterparts. They had adapted wing designs and advanced engines. These changes allowed Concorde to smash through the sound barrier, which is something subsonic commercial jets were simply unable to do.

The difference between a supersonic and a hypersonic aircraft is even more striking, because at hypersonic speeds the rules change completely. The previously benign air starts to become a serious problem, as aircraft moving at hypersonic speed generate huge amounts of friction. This results in temperatures hot enough to melt the frame of a standard jet, so hypersonic aircraft must be built from robust heat-resistant materials such as ceramics. And they can't stop there, because even if they are able to withstand the heat, the pressure at low altitudes is simply too great to fly at hypersonic speeds. Hypersonic vehicles need to climb high up into the atmosphere, where the air is much thinner, in order to lessen the strain on the aircraft.

Perhaps the biggest consequence of the intense airflow is that hypersonic vehicles can't even use the same engines as subsonic aircraft. Air moving through supersonic plane engines does so at subsonic speeds (the supersonic airflow is slowed by an engine inlet), but if you tried using a similar setup when travelling at hypersonic speeds, it would melt or simply explode before your eyes. But rather than rely on rocket engines – the only proven systems to power hypersonic vehicles – engineers asked themselves a more ambitious question: could we take what we've learned about the jet engine and design an equivalent that works at high supersonic, and even hypersonic, speeds?

This led to the invention of the supersonic combustible ramjet, or scramjet. Taking the principles of a jet engine and stripping away all of the unnecessary components for hypersonic travel – such as a turbine and a compressor – allows air to move through much more quickly. With few moving parts, these simple-looking engines produce enough thrust for an aircraft to soar at incredible speeds; and in doing so, have started to bring the future of air travel to life.

The scramjet

Meet the supersonic combusting scramjet, an engine that thrives at hypersonic speeds

"At hypersonic speeds the rules change completely"

'Ramming'
Air is forcibly packed into the engine due to the immense speed of the aircraft.

Supersonic flow
Airflow is slightly slowed to increase temperature and pressure but still flows through the engine at supersonic speeds.

Speed
Scramjets are most efficient at hypersonic speeds starting from around Mach 6.

Supersonic airflow
An inlet conditions the airflow before delivering it to the engine, where heat is then added in order to generate the thrust needed.

'Air-breathing' engine
Unlike rockets, scramjets rely on air from the atmosphere to burn their fuel.

Subsonic airflow
Air is drawn into the engine by turbines and compressed, slowing the flow to subsonic speeds.

Combustion
Compressed air combusts the fuel source and leaves at a higher temperature and pressure through the exhaust, producing thrust.

Speed
Conventional jet engines are capable of operating at speeds of up to Mach 3.5.

Scramjet engine

NASA X-43

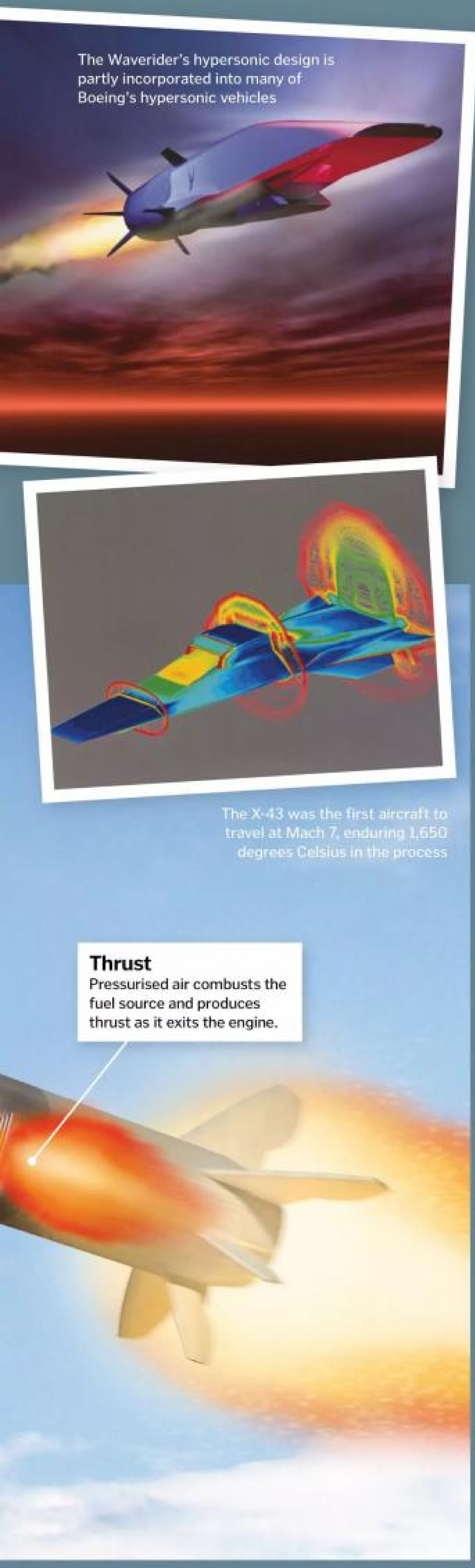
INTAKE AIRFLOW

HEATED EXHAUST

HEATED EXHAUST

INTAKE AIRFLOW

Conventional jet engine



The Waverider's hypersonic design is partly incorporated into many of Boeing's hypersonic vehicles

The X-43 was the first aircraft to travel at Mach 7, enduring 1,650 degrees Celsius in the process

MAKING HYPERSONIC FLIGHT A REALITY

We spoke with Boeing's chief scientist of hypersonics, Dr Kevin Bowcutt, about the future of high-speed travel

Dr Kevin Bowcutt is the senior technical fellow and chief scientist of hypersonics at Boeing. He is an AIAA Fellow, a Fellow of the Royal Aeronautical Society, and also a member of the National Academy of Engineering. He holds BS, MS and PhD degrees in aerospace engineering from the University of Maryland, US.

Why is Boeing so interested in hypersonic technology?
Boeing is interested in hypersonic technology for several reasons, including application to missiles, aircraft, and space planes. Hypersonic airplanes may someday whisk passengers and cargo across oceans in an hour or two, enabling international day trips. Perhaps most exciting of all, reusable hypersonic space planes may make transportation to Earth's orbit more like flying in an airplane than a rocket, and therefore much more affordable – up to 100-times cheaper.

What hypersonic technologies are you currently developing?
Key enablers to make hypersonic flight a reality include lighter and more durable high-temperature materials, increased hypersonic engine efficiency, and advanced sensing and data analysis technologies. On the technology front we are developing advanced high-temperature ceramic matrix composite materials, structures, and thermal protection systems. We are also developing, and have applied, advanced hypersonic vehicle design methods based on multidisciplinary design analysis and optimisation (MDAO). We have designed, and continue to study, hypersonic vehicle concepts such as missiles, reconnaissance aircraft, passenger airplanes, and reusable launch vehicles (space planes). We have built and successfully flown two scramjet-powered experimental vehicles, the NASA X-43A and the USAF/DARPA X-51A.

What are the main challenges you currently face?
Finding materials that withstand very high temperature, and that are lightweight and durable, remains a challenge, although good progress is being made in their development. Scaling up scramjets to larger sizes (beyond small jet engine size in terms of air flow rate) and speeds above Mach 7 is another difficulty due to ground testing limitations. Integrating low-speed and high-speed propulsion systems into combined cycle engines is another area for further development; combined cycle engines are required to accelerate from zero to hypersonic speed. Additional challenges include vehicle thermal management and thermo-structural health monitoring, as well as designing highly integrated systems such as hypersonic vehicles, driving the need for MDAO. On top of this, adequate funding is a perennial problem, although the situation is improving.

What is the overall goal of your project?
While Boeing is not developing a hypersonic airliner, and does not see a near-term demand for the product, we continue to research many advanced hypersonic concepts and technologies, so that we are prepared if the market develops for such vehicles. The potential for hypersonic aircraft in the future will require further advances in several areas of technology, as well as market demand. Ultimately, we want to help create the future of flight: ultra-rapid global transportation and routine and affordable space access.

How do you picture the future of hypersonic flight?
Although it's likely to be a few decades away, I envision a future where Mach 5 airplanes fly people between international cities in a couple of hours, and space planes routinely fly people to a hub in Earth's orbit for connecting flights to the Moon or Mars. Eventually, these vehicles will be powered by clean, high-density energy, probably some form of safe nuclear power.

© SPL; Alamy; US Air Force

THE FUTURE OF HYPERSONIC FLIGHT

Exploring the concepts that could one day replace the jet plane

If there's one lesson that we've learned about hypersonic flight so far, it's that heat, weight and power are all major obstacles. Too much weight, and you can't reach the desired speed. Too much heat, and your aircraft will melt mid-flight. And then there's the question of how we can power our machine to hypersonic speeds and keep it there. Fortunately, solutions for each of these critical problems have been suggested – and some seriously cool aircraft have been designed in the process.

Innovative engineers such as Charles Bombardier have been at the forefront of these endeavours. His envisioned aircraft, called Skreemr, would take to the skies with the help of an electrical launch system such as a railgun – so we could be bidding farewell to runways one day. A railgun is an electromagnetic strip that uses electricity to launch projectiles at incredible speeds, and could be used to fire the Skreemr into the air. This would eliminate the need for tons of extra rocket fuel for take-off, reducing the aircraft's weight considerably.

Another design by Bombardier, known as the Antipode, could tackle the heat problem as well as the menacing sonic boom. By using counter-flowing jets of air that move outwards in front of the aircraft, the temperature generated from aerodynamic friction and the sound produced by the sonic shock waves would be significantly reduced. And these features would help the Antipode fly up to Mach 24, equivalent to 29,500 kilometres per hour! These designs are still some time away from being realised, but Airbus and Reaction Engines have recently generated two concepts that could have us cruising at hypersonic speeds that much sooner.

Hypersonic hopefuls

Rival aerospace engineers are tackling the same mission in two very different ways

LAPCAT A2
REACTION ENGINES

ULTRA-RAPID AIR VEHICLE
AIRBUS

Passengers
Up to 300 passengers plus baggage can be transported, ensuring ticket prices remain competitive with those of subsonic airliners.

Airframe
The shape of the aircraft allows the pilot to maintain control across the full Mach range.

Rocket booster
As the turbojet engines are retracted, a rocket engine pushes the plane beyond Mach 1.

Mounted ramjet engines
These engines generate thrust once the aircraft has reached a high altitude and is travelling at supersonic speeds.

Rotating fins
Fins at the rear of the plane can switch between horizontal and vertical orientations for increased stability and speed control.

Rising to new heights

Airbus' Ultra-Rapid Air Vehicle will cruise over twice as high as today's airliners

Take-off
Jet engines attached to the fuselage would be used for taxiing and take-off.

Climbing
Once the aircraft has reached the lower stratosphere, the rocket engine ignites.

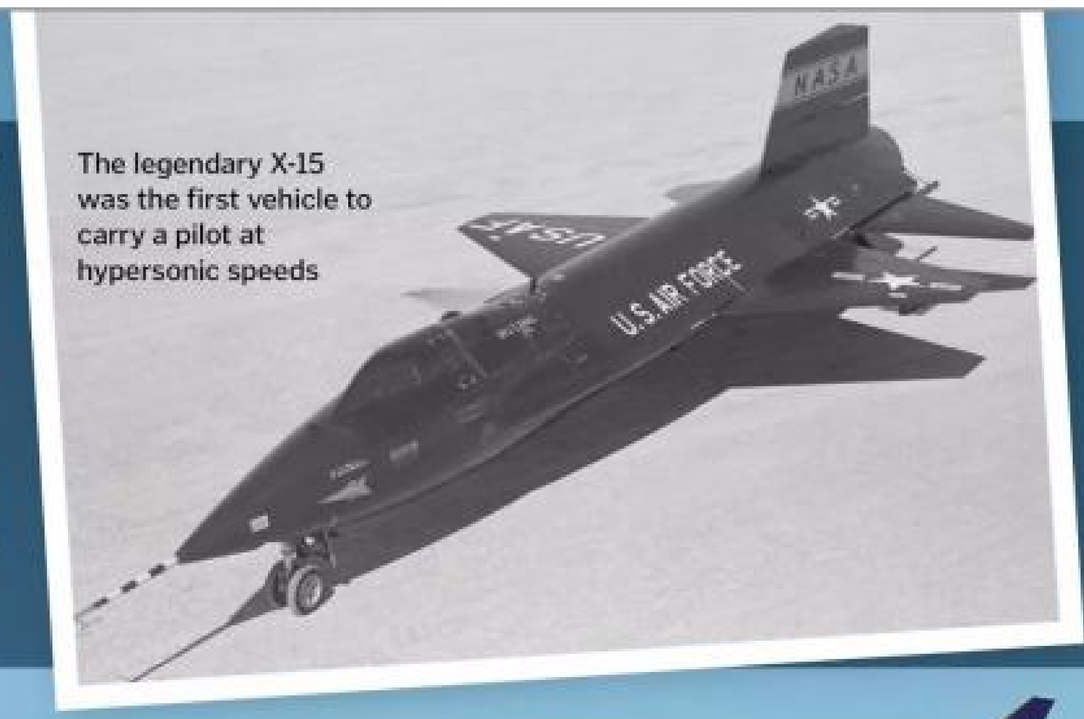
Accelerating
The aircraft breaks through the sound barrier while travelling vertically, causing the sonic boom to travel horizontally instead of towards the ground.

Cruising
Advanced ramjet engines are ignited when the aircraft reaches an altitude of 35km.

The history of hypersonic travel

It's been 60 years since a piloted vehicle first travelled faster than Mach 5, breaking the hypersonic barrier in a defining moment that showed the true possibility of space travel. The X-15 aircraft not only showed us that we could be carried at hypersonic speed, but taught us about how best to design, control and safely land a vehicle capable of achieving such a feat. The aircraft itself was essentially a rocket/plane hybrid, built to endure temperatures up to 700 degrees Celsius and fly at an altitude of over 100 kilometres, while being blasted through the air by a rocket engine at the rear.

Its achievements filled its creators with confidence that they could soon launch a vehicle into space at high speeds and bring it back into the atmosphere safely. Essentially, the X-15 played a role in putting humans on the Moon.



The legendary X-15 was the first vehicle to carry a pilot at hypersonic speeds

Fuel
Almost half of the aircraft's weight – approximately 400 tons – is its fuel mass.

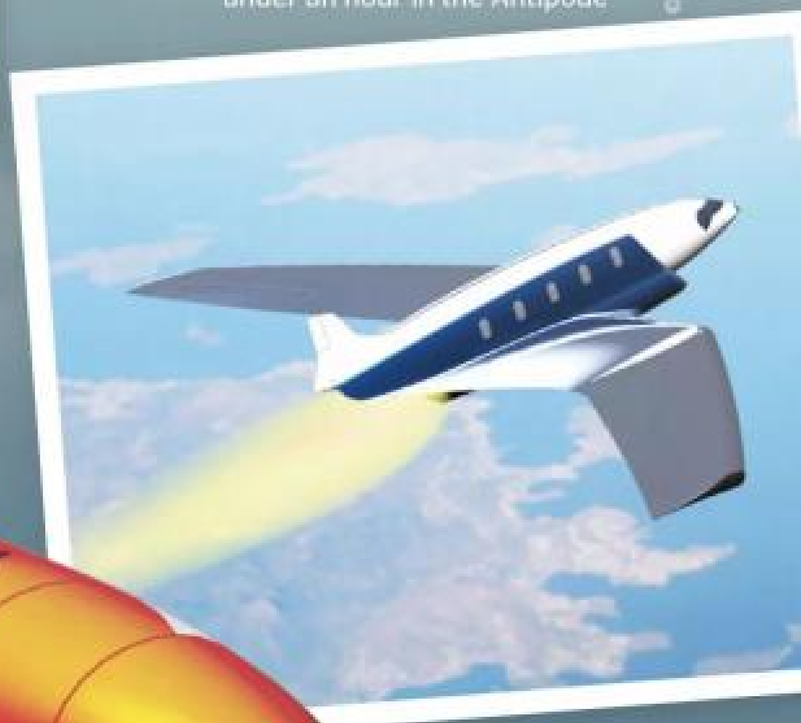
No view
Windows that can cope with the heat of hypersonic travel are expensive and heavy. Passengers may have internal screens linked to viewing cameras instead.

Turbo ramjets
A turbojet and a ramjet are combined into a single engine that is capable of take-off and landing, as well as cruising at hypersonic speeds.

Fuel tank
Airbus' design would be fuelled by on-board liquid hydrogen and liquid oxygen, as well as ambient oxygen from the air.

Passengers
This concept can carry up to 20 passengers along with two pilots.

Two passengers would be able to reach the other side of the world in under an hour in the Antipode



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The Skreemr would make use of an electrical launch system to accelerate to high speeds

Retractable turbojet engines
Conventional engines are used during take-off and are then withdrawn into the fuselage, making the vehicle more streamlined.

"We could be bidding farewell to runways one day"

HIGH-SPEED HOLIDAYS

It may soon be possible to watch the Sun rise in Paris and set in Tokyo

Most of us see travelling to the other side of the globe as the trip of a lifetime. Aside from the expense, these journeys take a very long time indeed. When we have to watch hours upon hours of in-flight entertainment on long-haul flights, it feels like we're lumbering through the air.

Ever since the world lost Concorde in 2003 we've been content to fly within the sound barrier. But the answer to our travel woes could be to punch right through it and go faster than any passenger plane has before. By flying at the upper limits of supersonic speed and into the hypersonic region, we could dramatically reduce travel times and change the way we explore the world.

The unique design of the aircraft has become the main challenge for revolutionising air travel. Most passengers probably wouldn't be comfortable strapping into a rocket and blasting across the planet. Using a rocket for international travel would also be infeasibly expensive, complicated and bad for the environment. Ideally, the hypersonic passenger carrier of the future will operate much like today's subsonic airliners. Passengers would be able to take their seats in a pressurised cabin, and the vehicle would be able to take-off and land unaided on a conventional runway.

Engineers have decided that using multiple engine types is the way to get this technology off the ground. Typical jet engines could be used for take-off and landing; a rocket engine could then propel us to great heights and speeds; and then the supersonic or hypersonic engine could take over. This would nevertheless be something of a thrill ride, as some designers believe their aircraft would have to take off near vertically! Those of us with a nervous disposition to flying may find it best to stick to the relatively sluggish speeds of a jumbo jet. However, for those holidaymakers and businesspeople who want to maximise the time spent at their destinations, and are willing to brave a vertical ascent into the atmosphere, hypersonic journeys will be the way forward.

Taking tourists to the upper stratosphere

Meet ZEHST, the Zero Emission High-Speed Transport of the future

Rocket power
Rockets take over from the jet engines after take-off to increase the aircraft's speed to at least Mach 2.5.

Jet engines
Subsonic jet engines are required for take-off and a safe landing.

Oxygen tanks
Unlike the other 'air-breathing' engines, the rockets require a source of stored oxygen for fuel combustion.

Liquid hydrogen
Two tanks of hydrogen are used to fuel the rockets and ramjets.

Lightweight materials
To compensate for the weight of multiple engines, the frame must be lightweight yet strong enough to endure high levels of aerodynamic drag.

Ramjets
When the aircraft's speed reaches 3,100km/h, air can be 'rammed' through the ramjets fast enough for the engines to produce thrust.

It would take a hypersonic vehicle only an hour and a half to travel from London to Cape Town

A hypersonic vehicle could get you from London to Sydney in less than three hours

Suppressing the sonic boom

Whether you're going supersonic or hypersonic, breaking the sound barrier is loud. As a vehicle accelerates, the waves of air pressure being pushed along by the frame begin to merge into one single shock wave. This air can travel at the speed of sound but as a vehicle surpasses this speed, a drastic change in pressure results in a deafening clap – a sonic boom.

The sonic boom is one major hurdle for aviation companies to overcome if hypersonic flight is going to be made available commercially. Concorde – the first and only public transport to break the sound barrier – was criticised for its volume and was only permitted to break the sound barrier over the ocean.

Like many aerospace issues, it could be NASA that comes to the rescue once again. The space agency and its partners at Lockheed Martin are in the process of designing an aircraft with many lifting surfaces to stop the airwaves from combining. The result would be a series of small booms rather than one big one – lowering the sound output to that of a normal conversation.

NASA and Lockheed Martin's Quiet Supersonic Technology (QueSST) X-plane design will be a step towards 'low-boom' supersonic travel

Helium tanks
Helium is used to pressurise the propellant tanks, allowing liquid hydrogen to be combusted in the rocket engines.

Passenger cabin
Up to 100 passengers can be carried in the pressurised cabin.

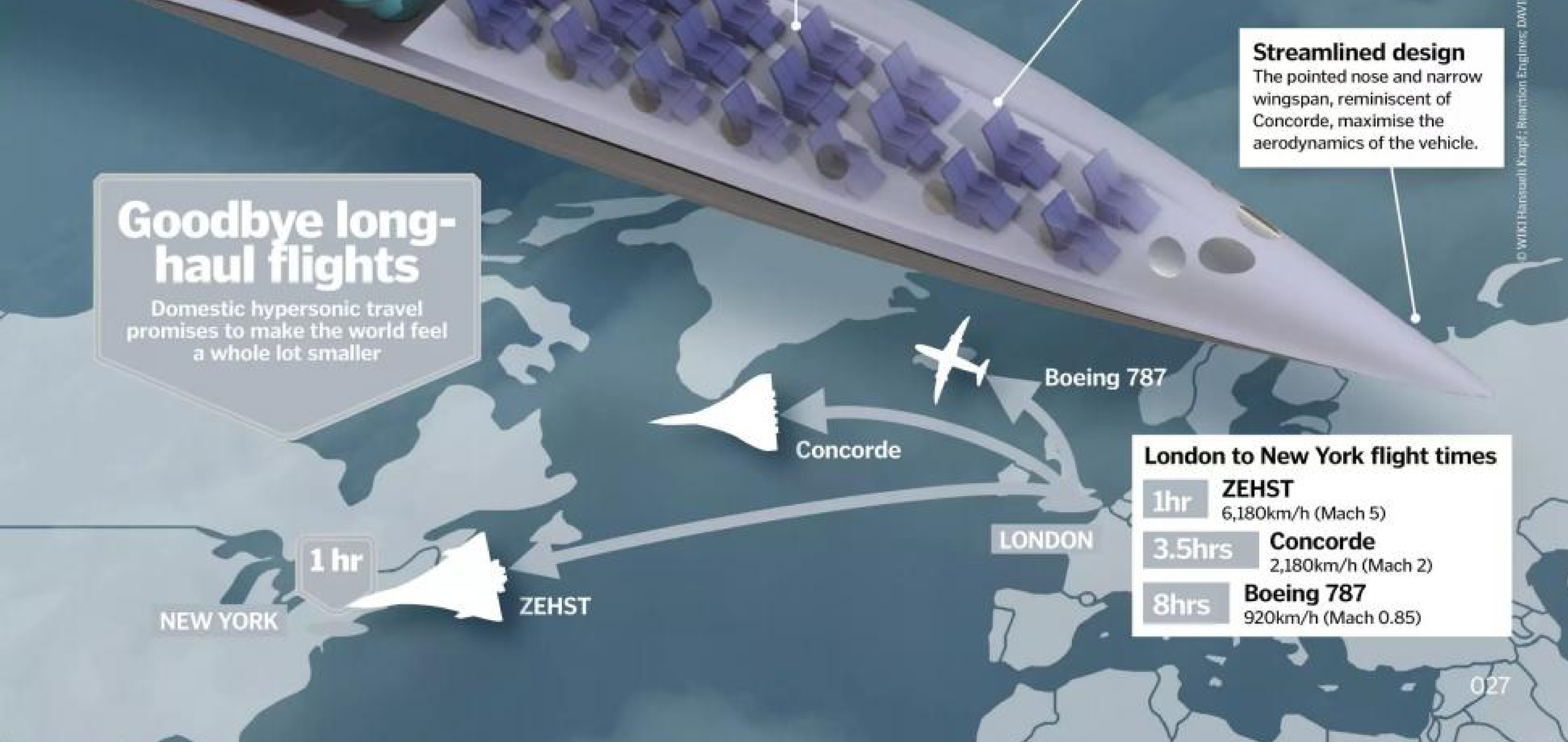
High altitude
To minimise air resistance the ZEHST would climb 32km above sea level for its journey – three-times higher than a Boeing 747!

Streamlined design
The pointed nose and narrow wingspan, reminiscent of Concorde, maximise the aerodynamics of the vehicle.

"Hypersonic travel would change the way we explore the world"

Goodbye long-haul flights

Domestic hypersonic travel promises to make the world feel a whole lot smaller



London to New York flight times

1hr	**ZEHST**	6,180km/h (Mach 5)
3.5hrs	**Concorde**	2,180km/h (Mach 2)
8hrs	**Boeing 787**	920km/h (Mach 0.85)

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