Seven Wonders of the Microbe World
Life on Mars

COMM
Microbes outnumber all other species and make up most living matter.

They're invaluable for humans to be able to survive and thrive - and we're continually discovering how to exploit them…including genetically modifying them to produce medicines, food and fuel.

Millions of years before humans appeared, microbes were thriving here on earth - yet less than half of one per cent of the estimated two to three billion microbial species have ever been identified.

Today, the search for new microbes, able to survive in the world's most extreme conditions, is helping us to address one of the last remaining challenges – is there life beyond earth?

Microbes thrive in an extraordinary range of habitats and often where no other life forms could exist. These include freezing conditions – very similar to the permafrost of Mars.

This could help us prove that life may have been possible on Mars – and on other planets too

CHARLES
The search for life on Mars is essentially a detective story. It's about looking for those tell tale signatures of life, maybe changes to rocks, maybe parts of microbes left over - those parts of the evidence that all come together and tell us that Mars once had life or maybe even has life.

ZITA
Mars and the earth share many physical similarities. For example, Mars has deserts, glaciers and polar caps. To help us, we're looking on the Earth for the most new and different microbes living in the most extreme environments which are similar to the environments on Mars, this way we can study signatures the microbes leave behind.

CHARLES
Scientists have found many rocks on Mars that look like they were in contact with water. And that tells us that there were environments on Mars that may have been like environments on earth. Environments that we know contain microorganisms. And this provides us with some compelling evidence that this is a planet that might once have harboured life.

ZITA
We're looking for signs of subsurface microbes living there now or in the past. We're looking for key indicators associated with life and these are the building blocks of the cell.

COMM
Once we know where to look on earth, we can design and build instruments, which can search similar environments on Mars.

In fact scientists testing equipment in similar geological conditions to Mars recently discovered a rare and complex microbial community living in blue ice vents inside the remote and frozen one million-year-old Sverrefjell Volcano in Norway.

COMM
We know that Mars once had water because we can see evidence of old river valleys. But the atmosphere on Mars is much thinner than earth, so it doesn't protect the surface from

radiation from space and makes life there impossible today. The only place where microbes might still survive, perhaps in pockets of water, is deep underground – so drilling is the only option, but it might mean going several meters below the surface.

CHARLES
Studying rocks that have been in contact with water or studying rocks that contain micro-organisms on earth, helps us develop instrumentation to go and look for this life on Mars. So it's really about gaining an understanding of where microbes are on earth to help us look for life on Mars.

COMM
This information is helping the development of a Life Marker Chip as part of the ExoMars Rover expedition in 2018. It's an instrument incorporated into the rover, travelling across the surface of the planet, collecting and analysing soil and rock samples, looking for specific molecules associated with life.

CHARLES
People get terribly excited about the possibility of life on Mars – but we have to remember it's just testing a hypothesis – it may be that we'll find no evidence of life on Mars in the most compelling places we think it might have grown. It would be just as remarkable to find no life on Mars as to find life on Mars because that would tell us that despite the fact that Mars was very similar to Earth in its early history something was missing for life.

The first organisms to be genetically modified were ECOLI bacteria, by Herbert Boyer and Stanley Cohen, in 1973. ECOLI is a common inhabitant of the human colon. It's simple to grow and can be easily manipulated and duplicated.

Today bacteria and yeast, which cause so many human diseases, are being genetically altered to help cure illness:

CHARLES
Genetic engineering is really about adding things to microbes. It's about rewriting their instruction manual to produce something different perhaps something useful to us like drugs – we're essentially turning them into tiny factories.

COMM
One example is insulin, which should be produced naturally in the pancreas to regulate the amount of sugar in the blood. When it's not produced we get diabetes. Previously natural insulin was extracted from the pancreases of cow and pig carcasses in abattoirs – but it was expensive, and it's difficult to ensure an adequate supply.

In the 1980s, scientists discovered how to produce human insulin by transplanting the genetic information for the human insulin hormone from a human cell into the DNA of the Ecoli bacterium.. This re-programmes the bacteria to produce insulin in just the same way as they make their own proteins.

In fact the genetic modification of microbes is transforming our ability to combat all sorts of diseases

CHARLES
A very good example of this is lacto bacillus. This is a bacterium that naturally lives in your gut. It protects you against urinary tract infections and other diseases and this microbe is now being engineered as a possible treatment for HIV.

PAULA
We have high hopes for a new malaria treatment produced by genetically engineered bacteria and yeast that will be cheap enough to give to anyone who needs it in South America and Africa.

COMM

As demand increases for alternatives to conventional fuels, scientists are hoping that genetically modifying microbes could also produce a sustainable solution to our energy needs. They want to use bacteria and yeast to break down organic waste products like the stems, leaves and husks from crops, and excrete biofuels like ethanol and butanol as their waste product.

PAULA
Ethanol has been heralded as a cleaner, greener fuel than petrol, and yeast naturally produces ethanol from sugars, an ability traditionally used to ferment beer.

COMM
This has huge implications since currently bio-fuel production uses starch crops like corn and sugar which are extremely expensive.

Microbes are also being genetically engineered into our clothing. Infusing clothes with bacteria or viruses may give them super properties, such as the ability to self-clean or naturally glow-in-the-dark.

So the tag on your t-shirt may one day read, "Ninety nine percent cotton and one percent E. Coli."