



The essential elements of life

1 1.0079 H Hydrogen	6 12.011 C Carbon	7 14.007 N Nitrogen	8 15.999 O Oxygen	15 30.974 P Phosphorus	16 32.065 S Sulphur
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Life-changing: Biochemist Felisa Wolfe-Simon has discovered that bacteria, left, found in the sludge of Mono Lake can replace sulphur, believed to essential to the creation of life, with poisonous arsenic to build its DNA

Malcolm Holland
 Science Reporter

THE building blocks of life on Earth, and the chances of life beyond it, have dramatically changed thanks to a poison-munching bug living at the bottom of a strange Californian lake.

NASA scientists yesterday revealed the microbes — common bacteria — live and thrive on arsenic.

It is the only known lifeform able to subsist on the deadly element — and the bacteria even uses it to build the backbone of its DNA.

Until yesterday it was believed six basic elements were needed for life: Carbon, hydrogen, nitrogen, oxygen, sulphur and phosphorus.

Biochemist and NASA research fellow Felisa Wolfe-Simon has for several years been investigating the possibility of “weird life” that did not need the six elements.

She and colleagues found it when they scooped mud from Mono Lake, a body of water so salty and alkaline that fish cannot live in it.

They cultured the bacteria from the mud in a broth of arsenic and phosphorus. The phosphorus was reduced over three months and, to their shock, the bacteria not only thrived but successfully incorporated the arsenic into its DNA, RNA and other biological architecture.

“That an organism can grow with this much arsenic is outrageous. We’ve cracked the door to what’s possible for life elsewhere in the universe,” Dr Wolfe-Simon said. The bacteria, called GFAJ-1 and related to the E-coli bacteria in our gut, was already known to science.

But scientists had previously only discovered types of bacteria that used arsenic as a fuel source.

“What is new here is that arsenic is being used as a building block for the organism,” study co-author Ariel Anbar said yesterday.

“We have had this idea that life requires these six elements with no exceptions . . . and here it turns out that maybe there is an exception.”

Australian scientists said the dis-

covery suggested life on Earth and beyond it could have evolved from a wider array of basic sources.

“That arsenic could be incorporated into molecules such as DNA instead of phosphorus will completely change how we perceive evolution of life on Earth and the possibility life elsewhere could also use different elements than assumed,” Dr Brendan Burns of UNSW School of Biotechnology and Biomolecular Sciences, said.

ANU Planetary Science Institute PhD candidate Aditya Chopra said researchers were excited because arsenic was often found at deep ocean hydrothermal vents and volcanic lakes.

“Perhaps life on Earth originated at such hydrothermal vents and it gives us another reason to study the possibility of life on moons of Saturn and Jupiter where hydrothermal vents might exist,” she said.