

## I BET YOU DIDN'T KNOW...

Dragons could save us from bad bacteria



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with the principles of  
primary science

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### Have you ever been ill and needed antibiotics to make you better?

All around us, on our skin and inside us, there are millions of bacteria. Many bacteria are harmless and even beneficial, such as the bacteria in our gut which help to break down food that we cannot digest. Other bacteria can cause harmful infections. Since the 1940s, humans have relied on antibiotics to treat bacterial infections. Most antibiotics that we use today were discovered and developed between 1940 and the mid-1960s. However, some of the bacteria that make us ill have been identified as potential 'superbugs' by The World Health Organisation because they have developed resistance to the medicines (antibiotics) that were developed to eradicate them (Table 1). You can investigate how easily bacteria spread between people using glitter mixed in a hand lotion.

### What do bacteria look like?

There are lots of images of bacteria online showing the basic shapes of bacteria: spirals, rods and balls (Figure 1). You could 'look' down an online microscope to see and learn about bacteria by visiting the Microbiology Society website. You could grow bacteria yourself by making yoghurt but note that primary schools are discouraged from growing microbes on agar plates (see CLEAPSS advice).

Figure 1. *Salmonella typhi* bacteria causes typhoid (high fever, diarrhoea and vomiting): an artist's 3D illustration (left), a pupil's 3D play dough model (right).



### How do antibiotics work?

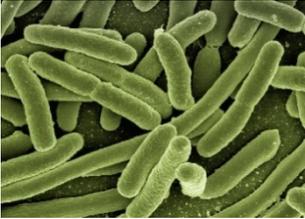
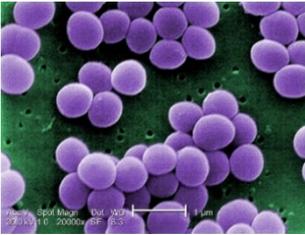
Scientists have found dozens of antibiotics, which fight bacteria in a variety of ways. Some antibiotics, including penicillin, work by attacking the cell wall of bacteria so that the bacteria cannot survive in the human body. Other antibiotics stop the bacteria multiplying. Different antibiotics have been designed to target different types of bacteria.

### Why have some bacteria become resistant to antibiotics?

This will depend on how the antibiotic worked against the bacteria. Scientists around the world are trying to understand this. Some have suggested that the bacteria could change shape so that they are not recognised by the antibiotic. Others have suggested that the DNA code inside the bacteria changes. For example, in 2015, scientists in China discovered that bacteria contained a gene (part of a DNA molecule) called MCR-1 which was responsible for making the bacteria resistant to antibiotic treatment. Since then, scientists all over the world have found this gene is present in bacteria in animals, in the meat we eat and in humans.

With reduced efficacy of antibiotics, humans need to find other ways to fight superbugs in the future.

Table 1. Types of harmful bacteria and potential treatments.

Bacteria	Disease	Treatments
<p><i>Streptococcus pneumoniae</i></p> 	<ul style="list-style-type: none"> <li>• Bloodstream infections</li> <li>• Ear infections in young children</li> <li>• Pneumonia (lung infections)</li> <li>• Meningitis (&gt; ½ million deaths each year around the world in children younger than 5 years)</li> </ul>	<p>Antibiotics (e.g. penicillin) but multi-drug resistant pneumococci are common and increasing.</p>
<p><i>Escherichia coli</i></p> 	<p>Most strains are harmless and live in the gut, but some strains can cause:</p> <ul style="list-style-type: none"> <li>• Food poisoning</li> <li>• Urinary tract infections</li> </ul>	<p>Patient care includes rest and fluids to prevent dehydration. In extreme cases, blood transfusions and kidney dialysis. In some cases, a short course of antibiotics is given.</p>
<p><i>Staphylococcus aureus</i></p> 	<p>Lives harmlessly on the skin and in our nostrils but can cause:</p> <ul style="list-style-type: none"> <li>• Pneumonia</li> <li>• Food poisoning</li> <li>• Wound infections</li> </ul>	<p>1940s - infections were treated with penicillin.                      1950's - <i>S. aureus</i> developed resistance to penicillin and another antibiotic (methicillin) was introduced.                      1961 - scientists identified methicillin-resistant <i>Staphylococcus aureus</i> (MRSA). MRSA is resistant to an entire class of penicillin-like antibiotics called <math>\beta</math>-lactams (penicillin, amoxicillin, oxacillin, methicillin).                      1990s - vancomycin was the only uniformly effective treatment, but <i>S. aureus</i> is still evolving, and some strains are now resistant to vancomycin.</p>

### Can scientists design new antibiotics that work against the 'superbugs'?

Scientists knew that the saliva of the Komodo dragon (Figure 2) contains lots of types of bacteria and yet this animal does not get ill. In 2017, researchers discovered a small protein (peptide) in the blood of the Komodo dragon that has antimicrobial properties (it kills bacteria). They copied the blood peptide and made a new synthetic peptide called DRGN-1. They showed that DRGN-1 killed two strains of bacteria including *methicillin-resistant Staphylococcus aureus* (MRSA) bacteria.

Figure 2. The Komodo dragon is a species of lizard found in the Indonesian islands.



**How do you think the scientists collected the antimicrobial protein from the dragon?**

**Why do you think that the scientists wanted to make a new protein in the laboratory?**

**What do you think this means for patients in the future?**

Another group of scientists noticed that colonies of leaf-cutter ants (Figure 3) are remarkably free from disease and that their colonies contain bacteria which produce their own natural antibiotics. Scientists from the University of East Anglia have collected hundreds of strains of this bacteria in the hope of developing new antibiotics [1].

Australian scientists have created star-shaped proteins, known as 'structurally engineered antimicrobial peptide polymers' (SNAPPS), which are able to pierce and make holes in bacterial cell walls [2].

Researchers have also been investigating a predatory bacteria (*Bdellovibrio*) which 'eats' other harmful bacteria present in wounds [3]. In the future they hope that researchers may be able to engineer strains of predatory bacteria to target specific harmful strains.

### Can scientists and engineers design new equipment to reduce the spread of bacteria?

Scientists are developing new equipment to use in hospitals to reduce the spread of infections. For example, automatic door handle sanitisers enable hospital staff and visitors to kill bacteria on their hands as they move between rooms.

### Could doctors diagnose infections more quickly before they spread?

Glowing bandages were developed at the University of Bath for burns patients. The bandages will glow if the wound becomes infected with bacteria, informing doctors immediately when antibiotics should be given.

### The paper that inspired this work was:

*Komodo dragon-inspired synthetic peptide DRGN-1 promotes wound-healing of a mixed-biofilm infected wound.*  
By Ezra MC Chung,<sup>1,4</sup> Scott N Dean,<sup>2</sup> Crystal N Propst,<sup>2</sup> Barney M Bishop,<sup>3</sup> Monique L van Hoek<sup>2</sup>  
*NPJ Biofilms Microbiomes* **3**: 9 (2017), <https://dx.doi.org/10.1038/s41522-017-0017-2> Accessed March 2020

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Figure 3. There are 47 species of tropical leaf-cutter ants which are all endemic to South and Central America, Mexico and parts of the southern United States.

