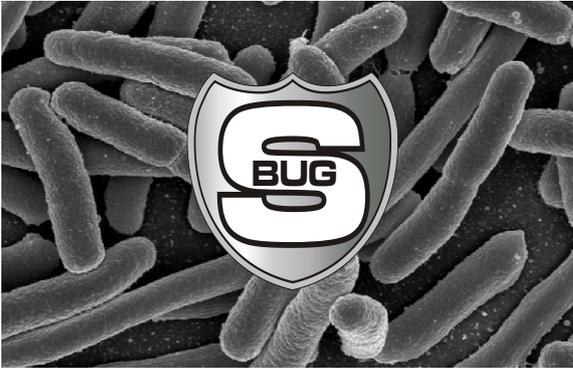




HOSPITAL SUPERBUGS - EVIDENCE FROM ANTIBIOTIC RESISTANCE

Number 4 in the Evidence series from Creation Research.

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**ARE BACTERIA EVOLVING?
IS ANTIBIOTIC RESISTANCE
EVOLUTION?
WHY DO BACTERIA CAUSE
DISEASE?
WERE BACTERIA CREATED?**

ARE THE GERMS WINNING?

One medical triumph of the 20th Century was the defeat of many bacterial diseases through the use of antibiotics. However, these old enemies are making a comeback as “superbugs” that can resist our most powerful antibiotics. Such resistant bacteria are often presented as proof of evolution. The logic is easy to follow: fifty years ago germ x was killed by antibiotics, but now it is not. Therefore, it must have evolved new characteristics that fight off antibiotics. One advanced Biology text book states: *We have to go on trying to find more and more antibiotics, because bacteria evolve to become resistant to them, as described in Section 16.10. The more we use antibiotics, the more selection pressure we put on bacteria to evolve resistance.* (Ref. 1)

Are Bacteria Evolving?

Evolution is a process where non-living chemicals evolved into primitive life forms that gradually changed into complex, fully functioning organisms. Bacteria are usually presented in textbooks as simple primitive organisms, yet all bacteria that have been studied are able to perform complex chemical processes that man has only been able to copy by sophisticated chemical engineering. Like all living organisms bacteria produce chemical energy, grow and reproduce themselves, and defend themselves from damage by unfriendly environments. It is this last property that has caused problems for humans seeking to kill bacteria with antibiotics.

WHAT ARE ANTIBIOTICS?



Antibiotics are substances that destroy bacteria by damaging their cell wall or by interfering with their biochemical processes so they cannot grow and reproduce. Many of these substances are naturally

occurring chemicals produced by other living organisms. The most famous antibiotic, penicillin, is produced by a fungus. Some antibiotics, such as Tetracycline and Erythromycin, are produced by a group of soil dwelling bacteria called *Streptomyces*. Scientists have been able to make antibiotics more effective by making changes to the chemistry of the original naturally occurring substances. Such antibiotics are called semi-synthetic, and were developed to kill bacteria that were resistant to natural antibiotics. Some bacteria are now able to resist them. Surely, it is argued, this new resistance must be evidence of evolution.

How do bacteria resist antibiotics?

Antibiotic resistance is a survival mechanism for bacteria. From the bacteria's point of view, any chemical that hinders its ability to survive is a poison it must avoid, or remove. The main methods of resisting antibiotics are as follows.

1. Changes to the permeability of the cell wall so that the antibiotic cannot get into the cell and damage it.
2. Enzymes - large proteins made by the bacteria that break down antibiotics or block their actions. These may be secreted into the surrounding environment to prevent the antibiotics gaining access to the bacteria.
3. Pumps that remove antibiotics from the bacterial cell before they can cause too much damage. These pumps may be non-specific, i.e. they will throw out many potentially harmful substances, such as dyes and detergents, as well as antibiotics. The “non-specific” property explains why some bacteria can resist synthetic substances that don't occur in the natural environment. The bacteria simply recognise that they are harmful and throw them out.