

**Questacon**

# Wired for Sound



Centenary of Federation

Great Australian science is helping deaf people to hear all over the world.

## WHAT'S THE PROBLEM?

About 120 million people around the world and about 1 million Australians have some degree of hearing loss. Of those 1 million Australians, 20 000 are profoundly deaf, that is they hear NO sound from the outside world, and more than 50 000 are severely deaf. Three in every 1000 children are born with a hearing loss or lose some hearing before learning to speak. This makes speech very difficult.

The reason that deafness is such a common condition is that our hearing apparatus is very delicate. Lets take a quick look at the human ear structure and how it works.

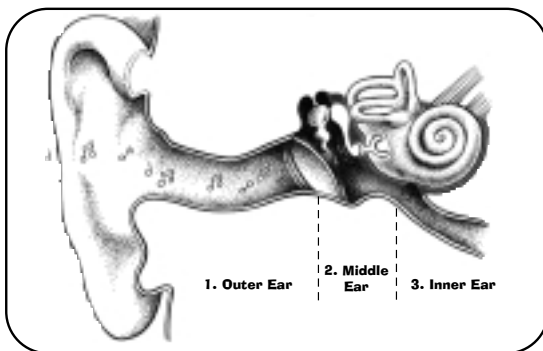


Illustration by Carolyn Brooks

- ◀ 1. external ear – collects sound and funnels it to the middle ear
- 2. middle ear – membrane (ear drum) vibrates when sound waves hit it, 3 tiny bones amplify the vibrations
- 3. inner ear – the cochlear has bony wall and is filled with fluid. Inside the cochlear tiny little hairs translate vibrations into electrical impulses which travel along the hearing (auditory) nerve to the brain and we hear a sound!

Corrective surgery and hearing aids can improve some forms of deafness but usually not profound deafness caused by inner ear damage.

## A GREAT AUSSIE SOLUTION

"Can you hear me?" This is often the first question heard by recipients of a cochlear implant (or 'bionic' ear)... simple but very exciting words if you have never heard anyone speak before!

By the year 2000, more than 24 000 severely deaf or profoundly deaf people in 50 countries had received a cochlear implant. They all owe their new hearing to technology first developed by Australian scientist Professor Graeme Clark and his colleagues at the University of Melbourne in the late 1960s and 1970s. Australian scientists have continued to be world leaders in hearing technology and the Australian cochlear implant is continually being upgraded



▲ Cochlear implants have helped many children

The cochlear implant replaces the function of the entire ear by directly stimulating the hearing nerves with electrical impulses to produce the same effect as sound.

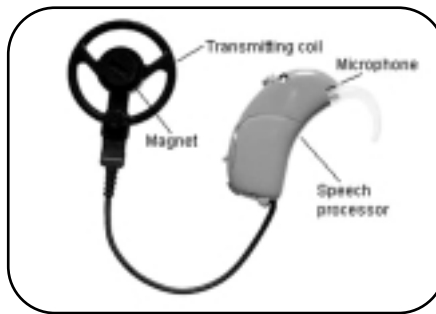
For details on how it does this turn the page...

## HOW DOES IT WORK?

The cochlear implant consists of an internal (the bit implanted under the skin behind the ear) and an external component which can be worn like a standard hearing aid or tucked away in the person's pocket. How do these bits work together to produce sound for deaf people?

1. Speech and other sounds are picked up by the microphone and sent to the speech processor
2. The processor codes the sound into an electrical signal, which is sent to the transmitting coil
3. The coil passes the signal through the skin to the implant, which transforms the signal to electrical pulses
4. The electrical pulses pass from the electrode array to stimulate the hearing nerve
5. The brain recognises the nerve stimulation as sound!

**The external or speech processing component of the cochlear implant** ▶



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## THE FUTURE

The cochlear implant relies on stimulating the 20,000 auditory nerve fibres through 22 electrodes. Current research is investigating ways to increase the amount of information provided by miniaturised advanced electrode designs and stimulation that more closely mimics the normal auditory system.

The importance of CRC research was highlighted when the Nucleus 24 Contour Electrode was awarded the 1999 Australian Design Award™ of the Year. The award judges said the Contour was '*an outstanding example of Australian innovative design and development which makes a major contribution to improving people's quality of life around the world*'.

### For more details contact:

CRC for Cochlear Implant & Hearing Innovation Centre

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## FURTHER INFO, FACTS & FUN

- An Australian man who became profoundly deaf after a head injury, was the world's first recipient in 1978. He regained partial hearing and the sound barrier was broken!
- More than 80% of the world's cochlear implant patients use technology manufactured in Australia.
- Australia has a strong history of excellence in medical research. Another revolutionary technology to do with sound (that no humans can hear), developed in the 1960s is 'ultrasound imaging'. Widely used in medicine to examine organs and unborn babies, ultrasound technology is now being used to help people with poor vision find their way around.
- Sound is produced by vibrating objects that generate pressure or sound waves. The faster the vibrations (or the higher the frequency of vibrations) the higher the sound. Try this with a ruler sticking over the edge of a table. When there is just a small amount of ruler hanging off the table and you flick it, it vibrates very quickly (has a high frequency) and produces a higher sound. When you sing a high note your vocal cords are vibrating more quickly than when you sing a low note.

### For more info on great Australian Science check out:

Questacon's Innovative Australians  
CSIRO's Australia Advances  
The Aus' Academy of Science's Nova

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