

## GLOSSARY:

**Auditory nerve:** Either of the eighth pair of cranial nerves that carries sensory impulses related to sound and balance from the ear to the brain.

**Cochlea:** The spiral-shaped cavity of the inner ear and the main hearing organ that contains the nerve endings that transmit sound vibrations from the middle ear to the auditory nerve.

**Cochlear implant:** A surgically implanted electronic device that allows people with severe hearing loss to recognize some sounds. It consists of a microphone and receiver, a processor that converts speech into electronic signals, and an array of electrodes that transmit the signals to the auditory nerve.

**Incus:** The middle of the three small ossicles in the middle ear, located between the malleus and the stapes. Also called the anvil.

**Malleus:** The hammer-shaped bone that is the outermost of the three auditory ossicles, articulating with the body of the incus. Also called the hammer.

**Mastoidectomy:** Any type of surgery that removes a portion of the mastoid bone. The mastoid bone is a part of the temporal bone - the bone that surrounds the ear.

**Periosteum:** The thick fibrous two-layered membrane covering the surface of bones.

**Polarity:** The property that produces unequal physical effects at different points in a body or system, as a magnet or storage battery.

**Stapes:** The innermost, stirrup-shaped bone of a chain of three small bones in the middle ear. Also called the stirrup.

**Tympanic membrane:** A membrane in the ear that receives sound vibrations and transmits them to the auditory ossicles, which are tiny bones in the middle ear. It is the lateral wall of the tympanic cavity, separating it from the external auditory canal. The membrane lies across the end of the external canal and looks like a flattened cone with its apex pointed inward. The edges are attached to a ring of bone, the tympanic annulus.



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# Show Me Science Advanced

## Audiology & Otology Cochlear Implants

K4607DVD

*Advanced Teachers Guide*

## SYNOPSIS:

In the United States, 12,000 babies are born annually with hearing loss. Doctors at the University of Miami's Ear Institute help patients that are diagnosed and prepared for cochlear implant surgery. A cochlear implant is a small, complex electronic device that provides the sense of hearing to patients who are profoundly deaf or are severely hard of hearing.

The implant helps patients hear when electrodes along the array stimulate the remaining auditory nerve fibers in the cochlea. The electrical sound information is sent through the auditory system to the brain for interpretation.

In this issue, students will learn the benefits of cochlear implants, how the ear works, and the anatomy of the inner and outer ear.

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## CURRICULUM UNITS:

- Anatomy
  - Biology
  - Engineering
  - Physics
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## CAREER OPPORTUNITIES:

- Anesthesiologist
- Audiologist
- Doctor
- Ear-nose-throat specialist
- Nurse
- Speech pathologist

## PROGRAM OVERVIEW:

Cochlear implants assist people who have lost their sense of hearing. The implant consists of an external part and an internal part. The external part contains a microphone, battery, magnet, transmitting radio frequency antennae, and a sound processing microcomputer.

The internal part consists of a receiver/stimulator and includes a micro computer, radio antenna, magnet and electrode array. The magnets are of opposite polarity and hold the external device in place over the internal device. The implantation procedure is a delicate one, especially considering many are performed on small children.

Sounds send vibrations or sound waves through the ear opening, down the external ear canal, and strike the eardrum, causing it to vibrate. The vibrations are passed to the three small bones of the middle ear, which transmit them to the cochlea. The cochlea contains tubes filled with fluid. Inside one of the tubes, tiny hair cells pick up the vibrations and convert them into nerve impulses. These impulses are delivered to the brain via the hearing nerve, and the brain interprets the impulses as sound.

## ISSUES & CRITICAL THINKING:

1. Discuss the nature of sound being a form of energy that travels in waves. What happens to sound waves as they encounter different mediums, including solids, liquids, and gases.
2. Students should understand that sound waves travel in a given direction until an outside force or object disrupts its motion and reflects it, and that sound can travel through different mediums, including solids, liquids, and gases.
3. Explain how the human ear works, interpreting sound waves and sending messages to the brain. Have students diagram the components of the inner ear.
4. Have students gather information on the different types of waves (transverse, longitudinal, surface). Give examples of each from the natural world. What type is a sound wave?