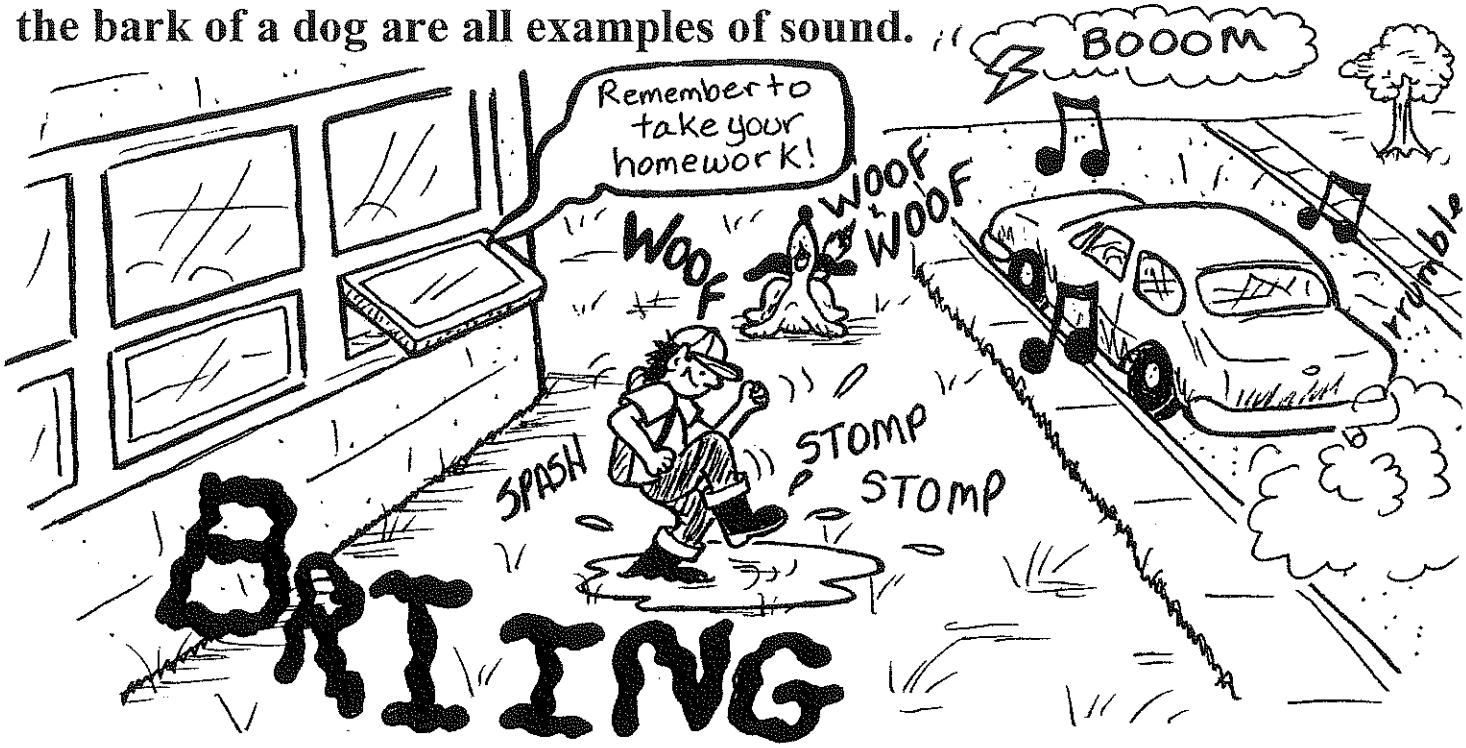
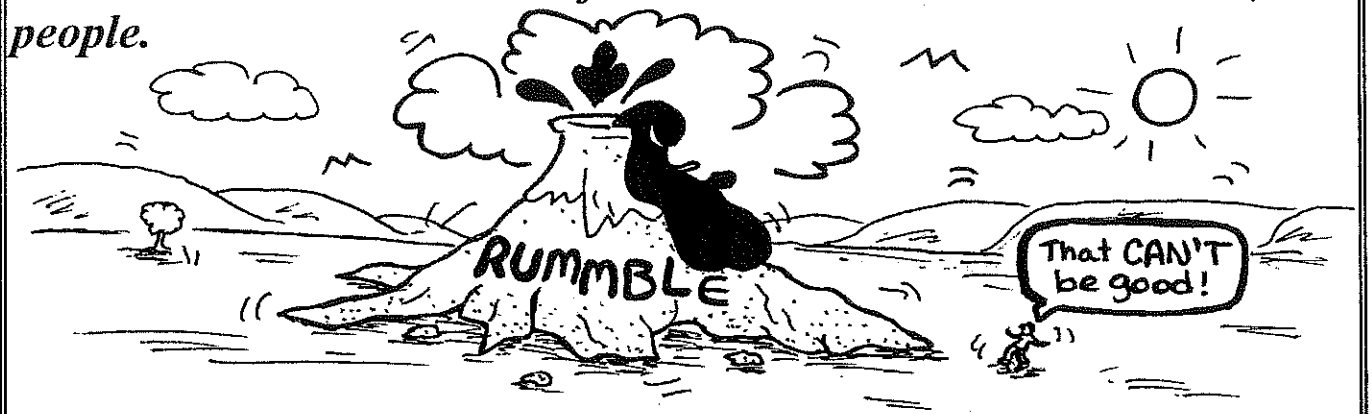
Sound Hearing And Speech

Sound

Sound is a type of *energy* that is all around us. The voices of other people, teachers telling students to do their homework, the stomping of feet, music, traffic noise, the crack of thunder, or the bark of a dog are all examples of sound.



Factfile: The loudest sound ever heard was likely the volcanic eruption of Krakatoa. The volcano erupted in 1883 and the explosion was able to be heard over 5000 kilometers away. The blast threw rocks distances of 55 kilometers and killed over 36,000 people.



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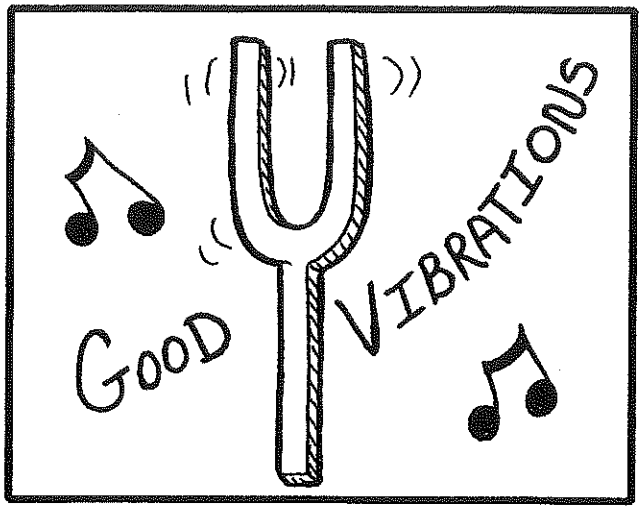
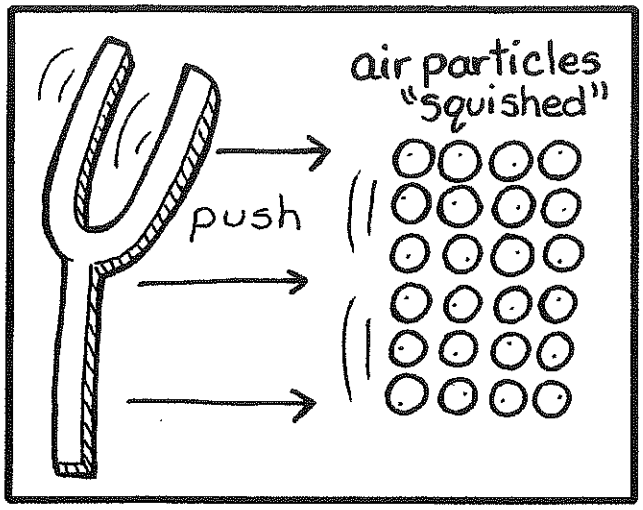
How Is Sound Made? - Producing Sound

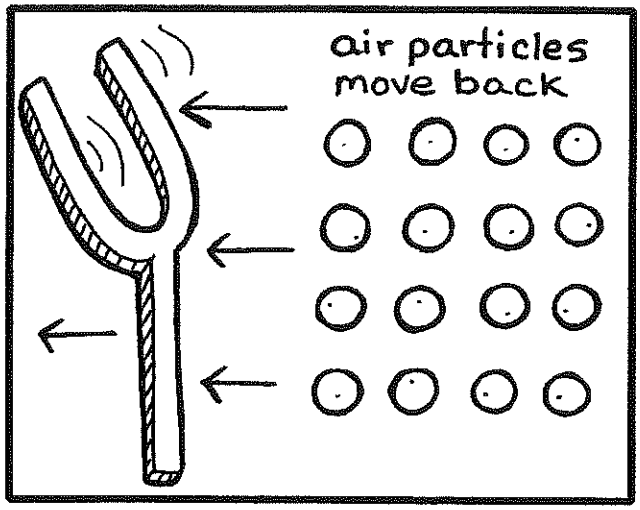
Sound is made when an object moves back and forth very rapidly or *vibrates*. The vibrations "push" on the air around the object creating waves.



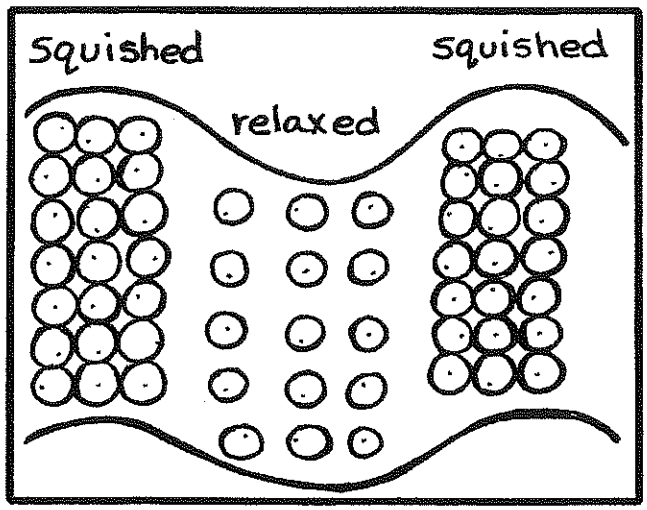
1) Object vibrates.



2) The object "pushes" on the air around it creating a wave. (This causes particles in the air to be "squished" closer together.)



3) The object stops and moves in the opposite direction. (This causes particles in the air to move further apart.)



4) The object changes direction again and the push makes another wave. The process repeats.

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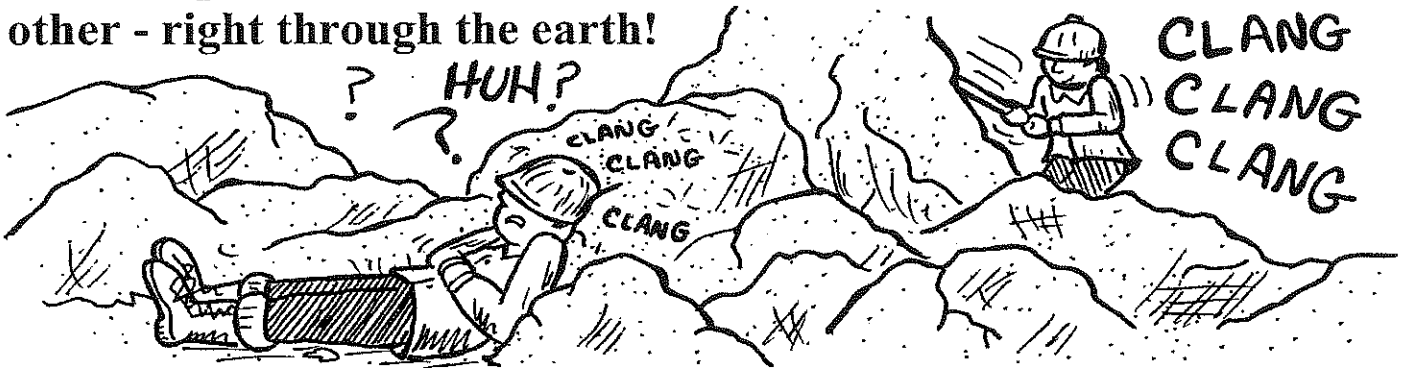
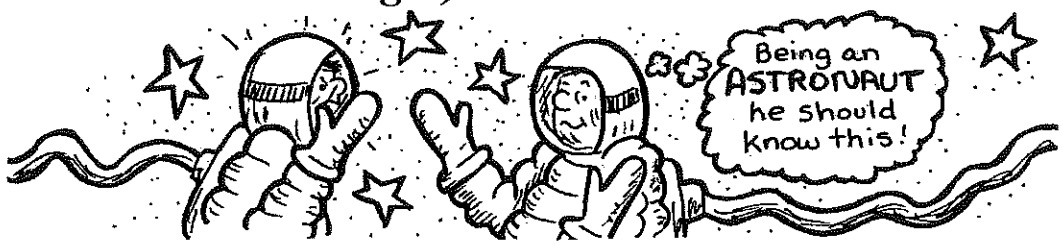
How Sound Travels

Sound travels in *waves* much like a rock being dropped into a small pond. These waves travel outward in all directions from the object that is causing the vibration.

Although the sounds that we usually hear travel through the air, sound will also travel through any other type of matter - solid, liquid or gas. Examples include: tapping a rock on a pipe (steel), yelling to a friend while swimming (water) or scratching the end of a ruler (wood or plastic). Sound vibrations created in an earthquake will even travel from one side of the planet to the other - right through the earth!



Factfile: Sound will not travel in outer space. (Space is a "vacuum", meaning there is no air (or anything else) for vibrations to travel through.)



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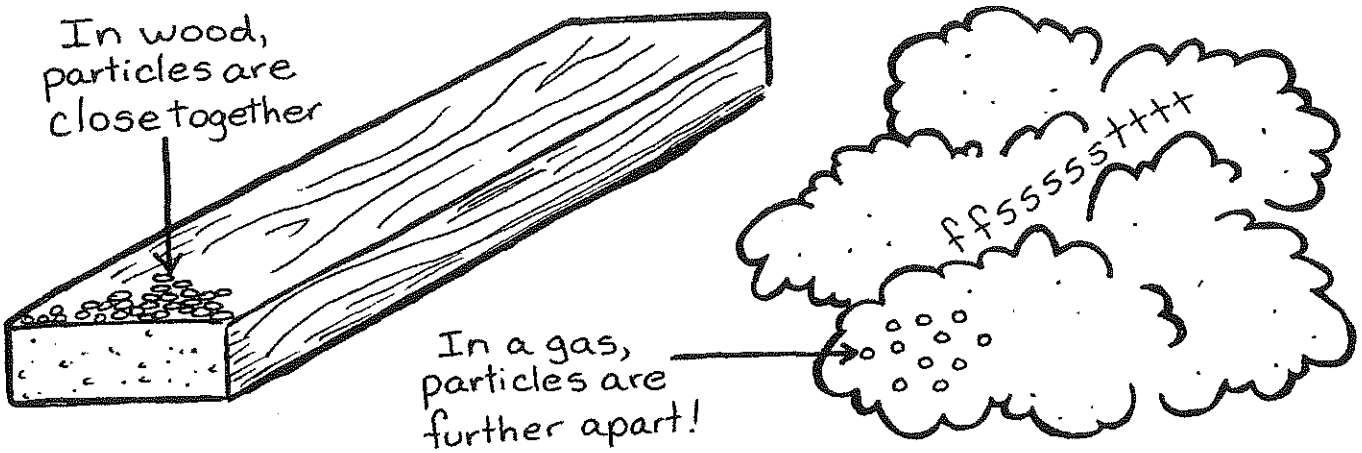
The Speed Of Sound

How fast sound travels though a material depends on the material, *not* the object making the vibrations. More dense materials like solids or liquids are made up of particles that are closer together. Sound travels fastest in these types of materials such as steel, wood or water. In gasses, the particles are much further apart, which causes sound to travel much more slowly.



Factfile: In air, sound travels at a speed of over 300 meters in one second! When a plane moves faster than the speed of sound (breaks the sound barrier) it creates an enormous shock wave in front of the plane called a "sonic boom". If the plane breaks the sound barrier too close to a city or town, windows can be shattered by the sonic boom it creates.

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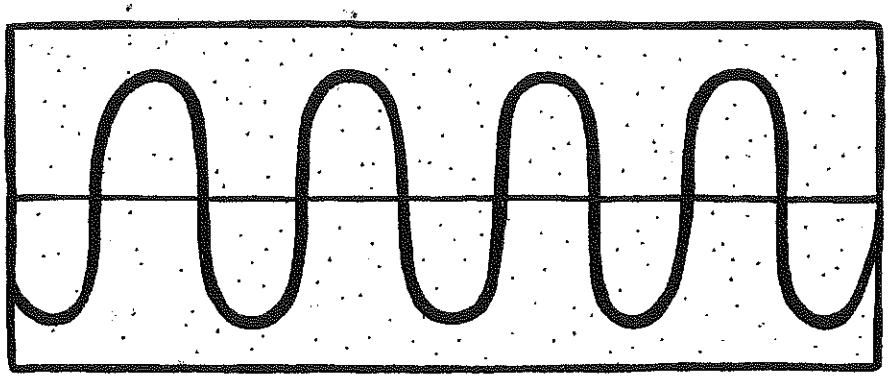
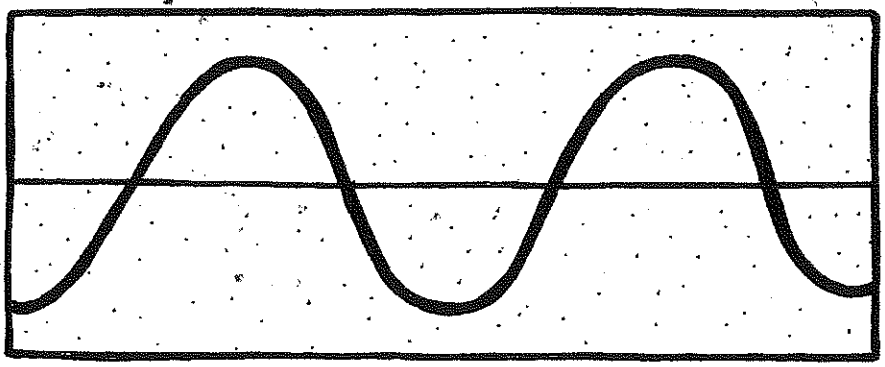
High Sounds - Low Sounds

Frequency - how fast or slow an object is vibrating
Pitch - how high or low a sound is

When an object is vibrating very fast, the waves of sound that it will create will be close together. These "close together" sound waves will have a high *frequency*, will sound higher and are said to have a high *pitch*.



The opposite is true. If an object vibrates more slowly, the waves will be further apart and have a lower frequency. The sound produced will be lower and have a low pitch.



Factfile: Why is the buzzing of a mosquito much higher in pitch than the buzz made by a honeybee? Smaller objects tend to produce vibrations with a higher frequency than larger objects. The tiny, fast-moving wings of a mosquito will create vibrations with a much higher frequency and pitch than the larger, slower wings of a bee.

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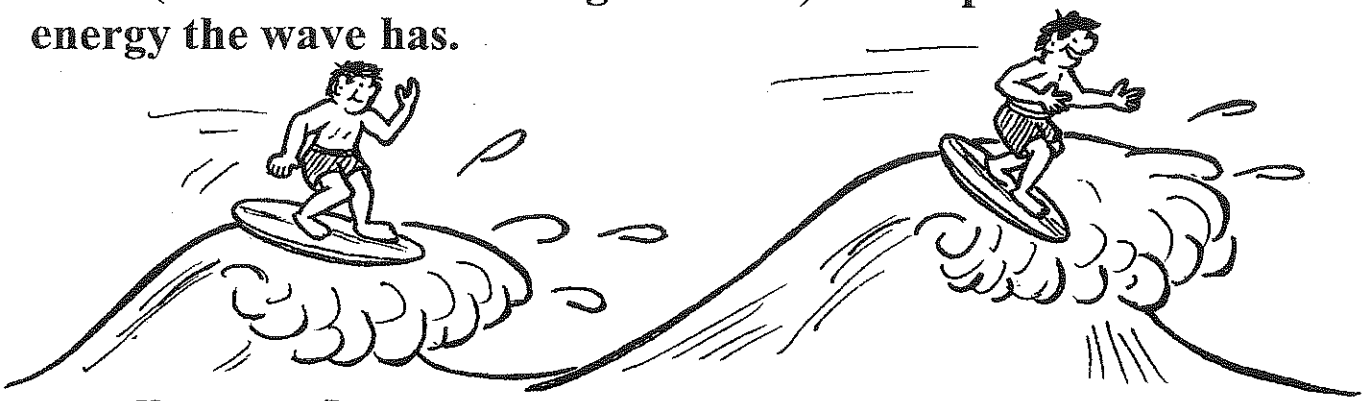
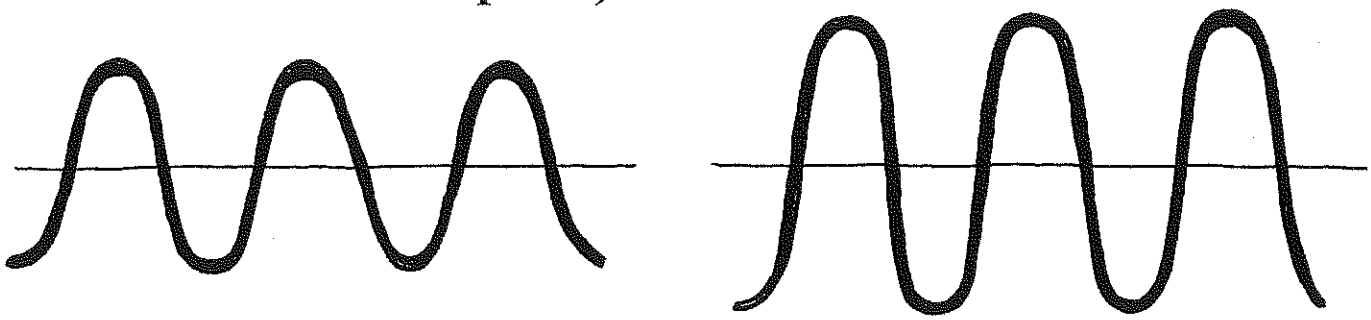
Loud Sounds - Soft Sounds

For waves on a lake or ocean, the "height" or "amplitude" of a wave (measured from trough to crest) tells a person how much energy the wave has.



small waves (less energy) **large waves (more energy)**

This is the same for sound waves. The second sound is louder because the "height" of the waves is larger. (Note that the frequency of both sound waves shown is the same so they both would be at the same pitch.)



quiet sound (less energy) **loud sound (more energy)**

Decibels **are used to measure the loudness or softness of a sound. An empty room would be about 10 decibels, a classroom working on an assignment would be about 50 decibels and a very noisy class would be about 80 decibels. Sounds that are too loud (above 100 decibels) can cause permanent hearing loss.**

Factfile: Decibels are named after Alexander Graham Bell, the Canadian who invented the telephone in 1876.

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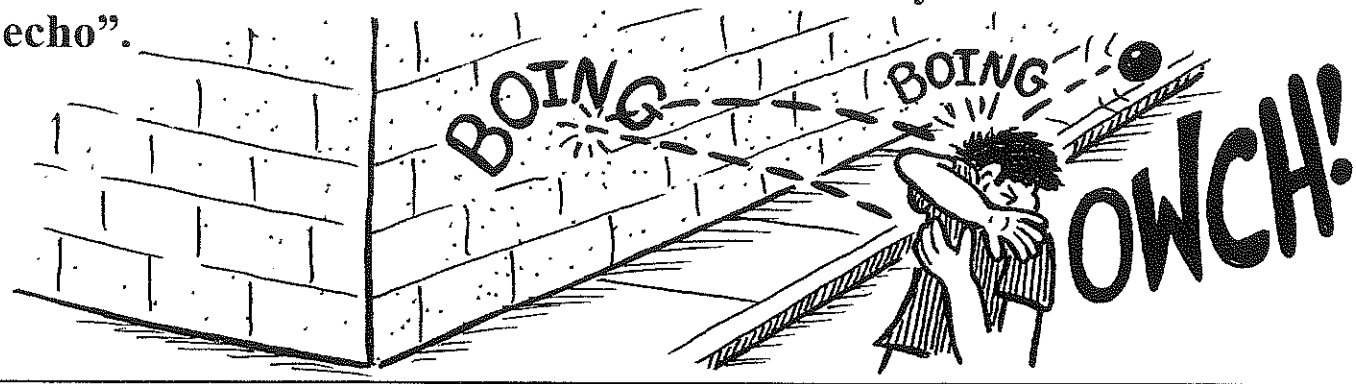
Reflection Of Sound

If a person threw a rubber ball at a hard brick wall it would bounce back. When sound waves hit a similar hard surface they also bounce or reflect back. This is commonly known as an "echo".



Factfile: Bats use echolocation to help them track down food. They send out high-pitched sounds which are reflected back to their sensitive ears telling them where their next meal is.

While hard surfaces, like rock or concrete, reflect back most of the sound that reaches them, other "softer" materials will absorb sound. Recording studios have sound-absorbent insulation on the walls to stop echoing. Foam earplugs will absorb most of a loud sound before a person's hearing will be damaged.

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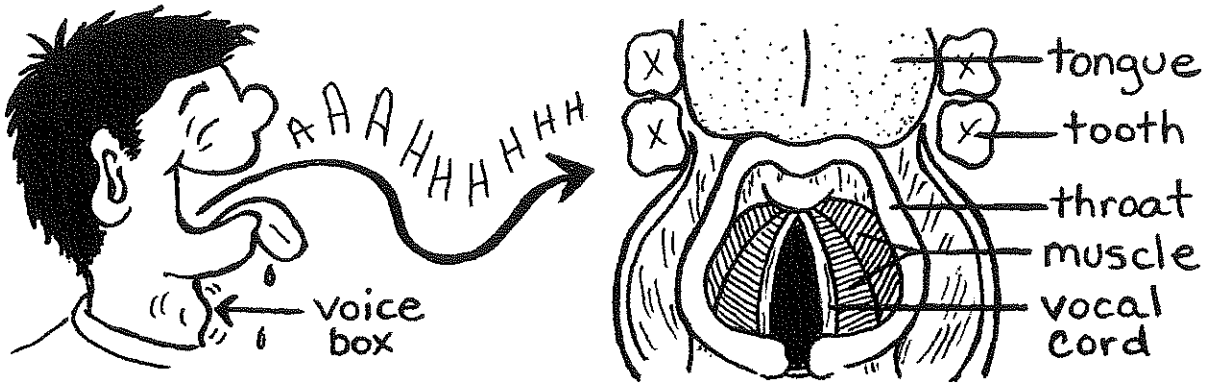
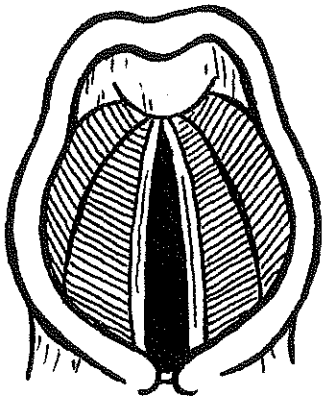
Vocal Cords - The Human Voice

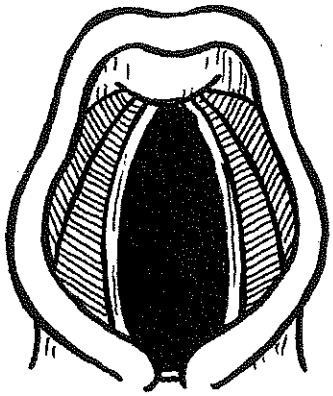
The human voice is produced inside the voice-box or larynx. Inside are two thin strips of tissue which are stretched across the larynx, called vocal cords. The vocal cords form a tiny slit which can let air from the lungs through. When air is pushed out of the lungs, it passes between the two vocal cords and creates vibrations which we hear as a human voice.



Muscles attached to the vocal cords can tighten to make the slit smaller, or loosen to make the slit bigger. By changing the size of the slit through which the air is passing, a person can make their voice higher or lower.



muscles tighten
slit gets smaller
voice gets higher



muscles loosen or relax
slit gets larger
voice gets lower

Factfile: The larynx can be felt on a person's throat and is sometimes called the "Adams Apple". It is usually bigger and easier to see in men.

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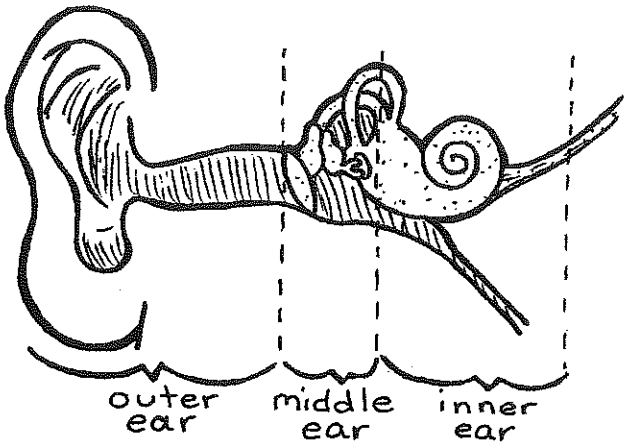
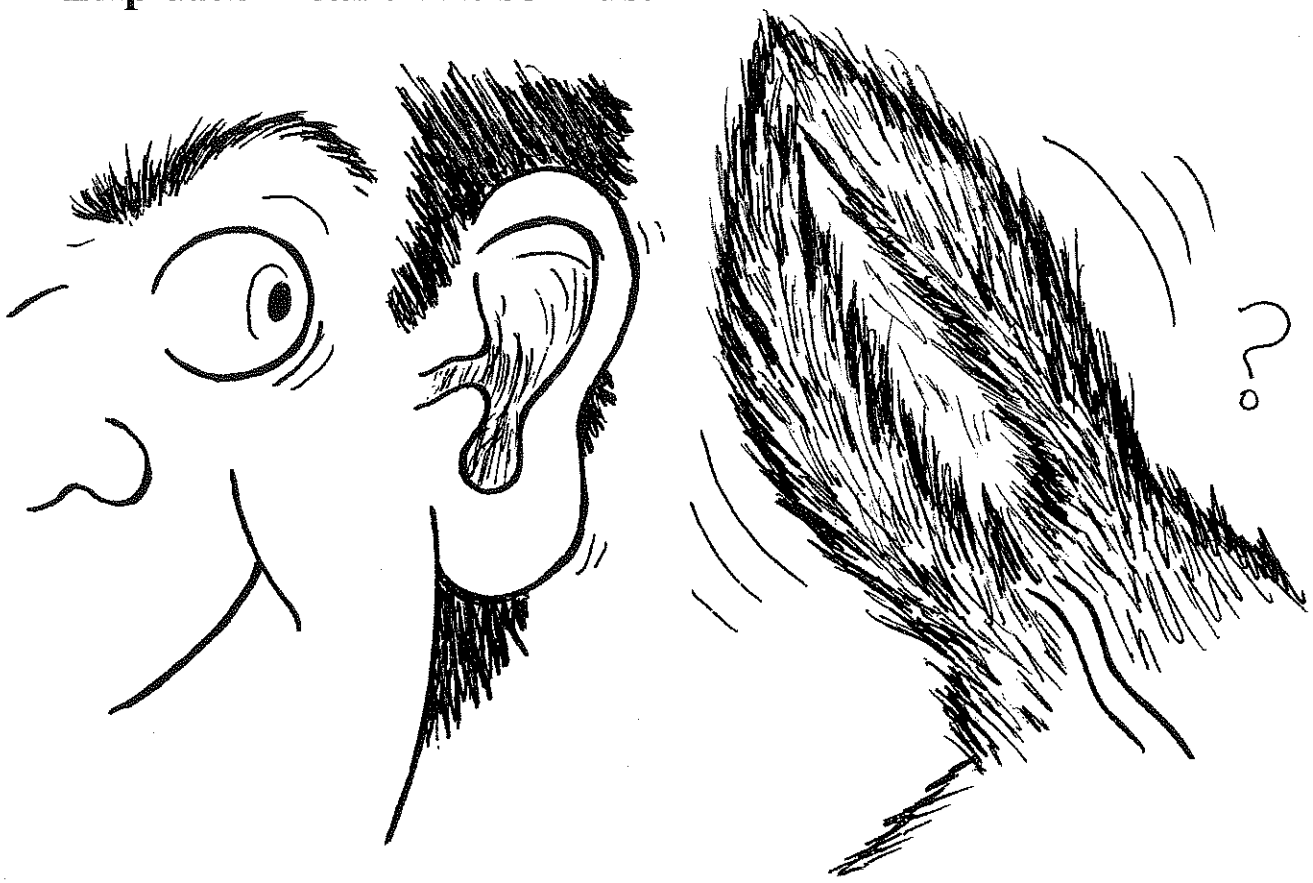
The Human Ear

The human ear can be divided into three main parts called the outer ear, the middle ear, and the the inner ear.



1) The Outer Ear

The outer ear consists of the pinna and the ear canal. It acts like a funnel to pick up sound waves from the air, focus the vibrations and send them along the ear canal to the middle ear. Animals with highly developed senses of hearing (like deer and rabbits) usually have large pinna to help them hear faint sounds.



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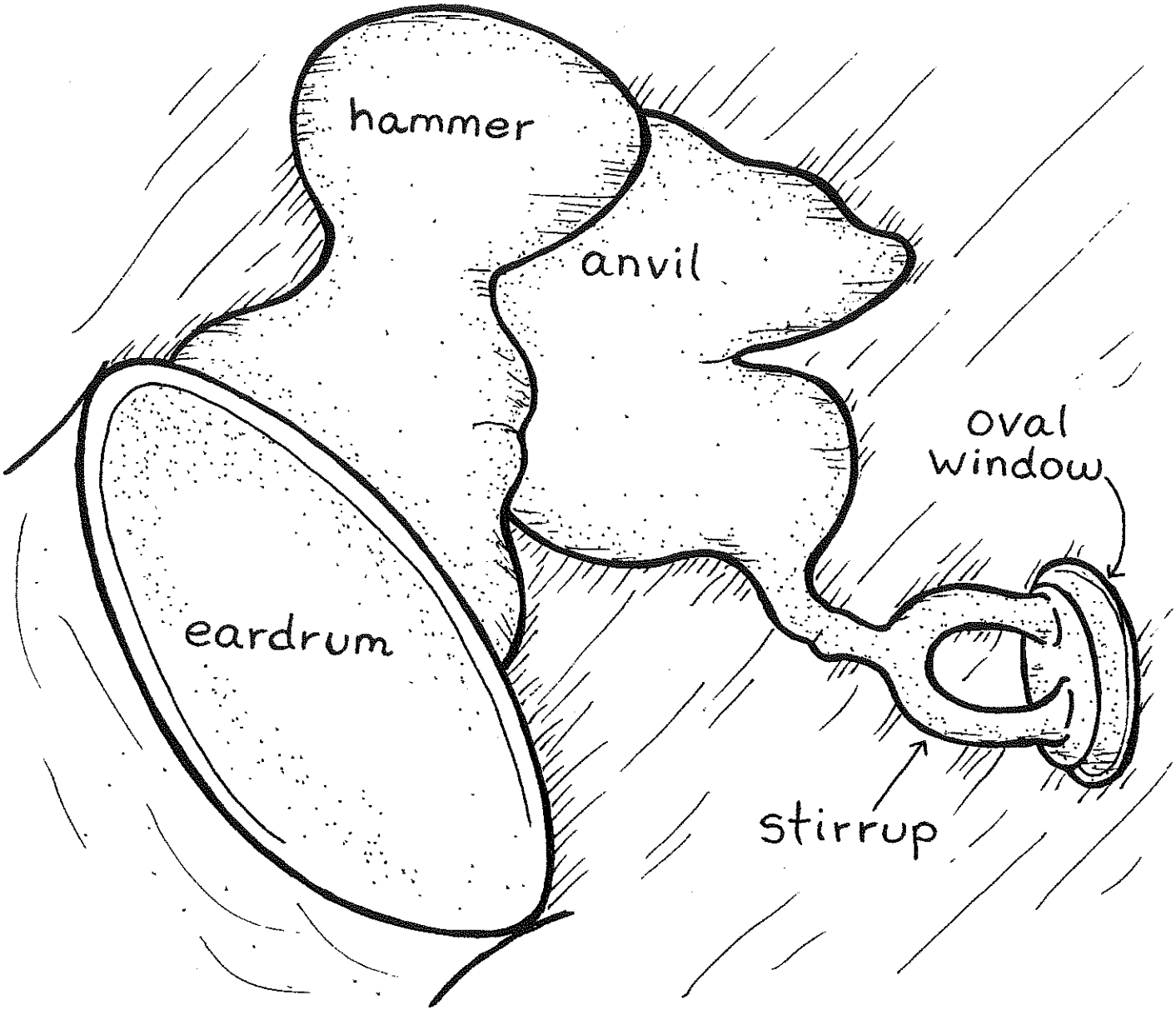
2) The Middle Ear

The middle ear consists of the eardrum, small bones called the hammer anvil and stirrup and the oval window. Sound travels down the ear canal to the eardrum and the beginning of the middle ear. The eardrum is a thin piece of skin called a membrane (like the skin on a real drum) that vibrates when the sound reaches it. This, in turn, causes the hammer, anvil and stirrup (the three smallest bones in the human body) to vibrate on another smaller membrane, called the oval window. The middle ear is very delicate and damage to any of the parts is quite serious.



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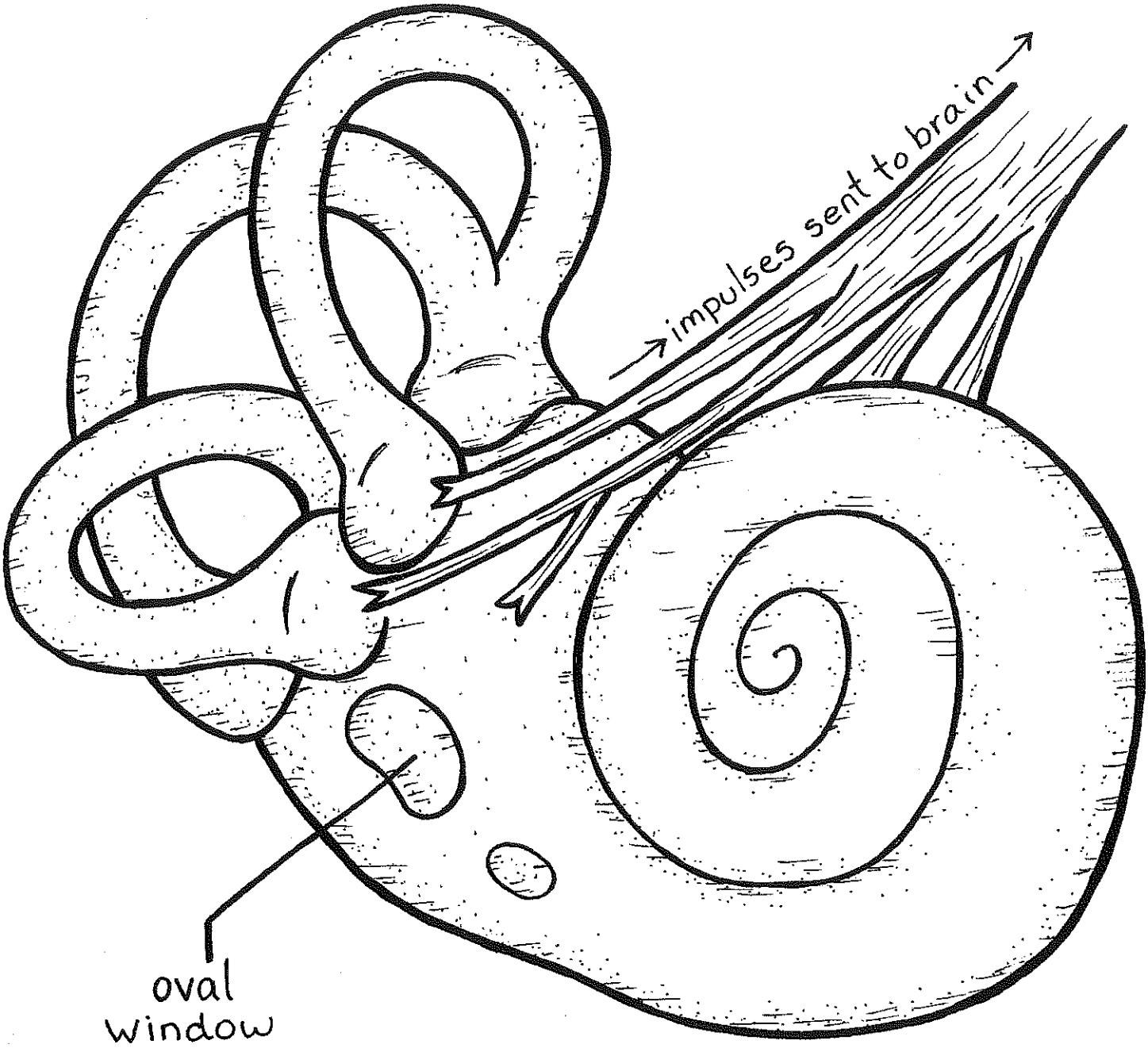
3) Inner Ear

The inner ear is made up of a hollow, snail-shaped bone called the cochlea which contains fluid and small hairs inside it. Vibrations from the movement of the oval window cause the hairs to move. These impulses are then sent to the brain which interprets the sounds. (A second job of the inner ear, besides hearing, is to help with balance.)



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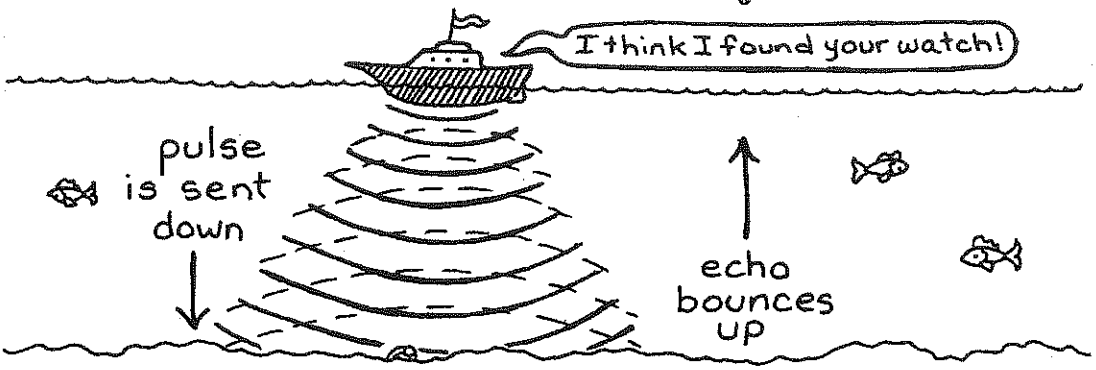
Uses Of Sound

Sound has many uses. Some of these include:

1) **Sonar - submarines, ships and some fish-finders, use soundwaves to help them detect objects underwater.**



2) **Ultrasound - very high-pitched sound waves (too high for humans to hear) can be used to take a "sound picture" of a baby inside a mother's womb.**

3) **Ultrasound - is also used by jewellers for cleaning precious stones and by physiotherapists to help repair torn and damaged muscles.**

4) **Kidney Stone Smashers - pulses of strong sound waves are used to break apart painful kidney stones without requiring an operation.**

5) **Microphones - sound waves are turned into electrical waves and then amplified so that we can hear and record them.**

6) **Music - sound provides entertainment and enjoyment.**

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