# Sonography (Ultrasonography): Basic Principle and Applications

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# Depend on frequency sound waves are classified in three categories

## SOUND WAVES

**Infrasonic waves**

0-20HZ

**EARTHQUAKE**

**Audible Range**

20HZ----
20000HZ

**Ultrasonic waves**

20000HZ-5 MHZ

BATS,QUARTZ CRYSTAL

Rhinoceroses use infrasonic frequencies as low as 5 Hz to call one another

Bats use ultrasonic frequencies up to 100 kHz for locating their food sources and navigating

# Properties of ultrasonic waves

1. They have a high energy content.
2. Just like ordinary sound waves, ultrasonic waves get reflected, refracted and absorbed.
3. They can be transmitted over large Distances with no appreciable loss of energy.
4. If an arrangement is made to form stationary waves of ultrasonics in a liquid, it serves as a diffraction grating. It is called an ***acoustic grating.***
5. They produce intense heating effect when passed through a substance.

# Uses of Ultrasound

## Obstetrics and Gynecology

The development and monitoring of a developing foetus

## Cardiology

Seeing the inside of the heart to identify abnormal structures or functions and measuring blood flow through the heart and major blood vessels

## Urology

- measuring blood flow through the kidney
- seeing

# Ultrasound Equipment

**Screen/Displa**
**y**

Transducer
pulse controls

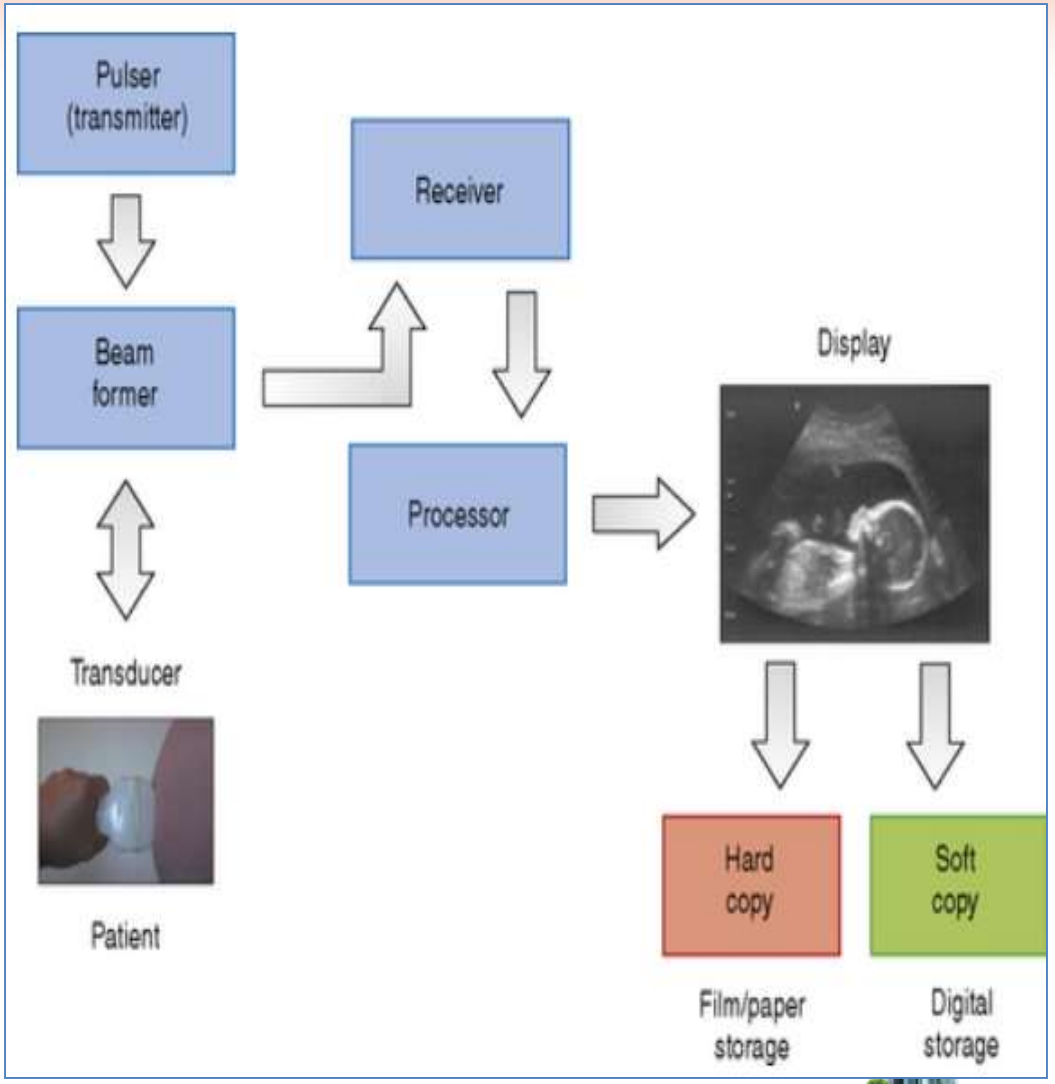
Computer

**Various**
Transducer

Portable

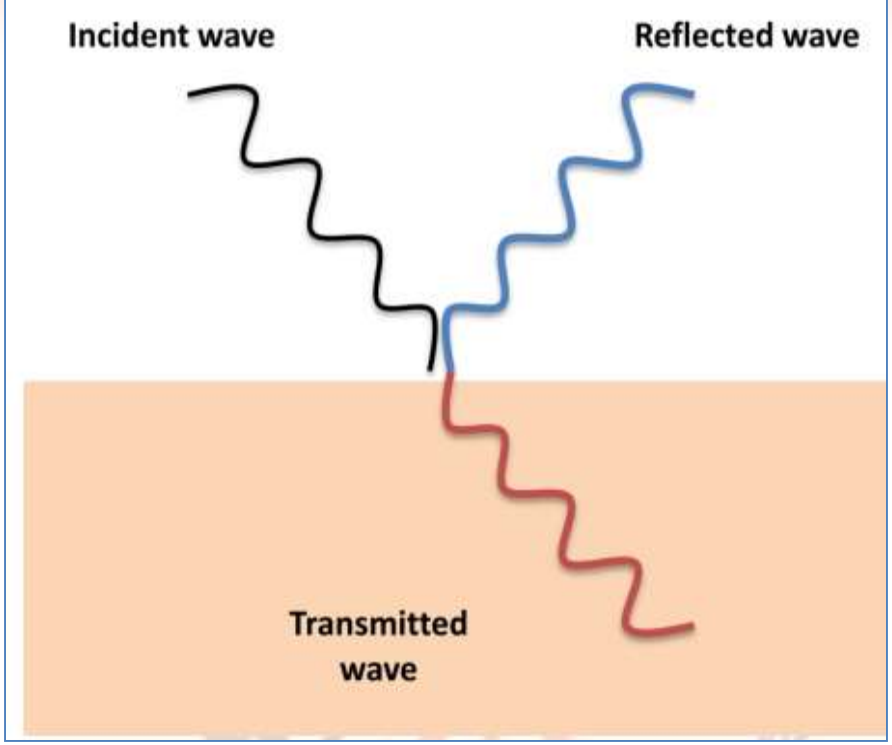
# COMPONENTS OF A TYPICAL ULTRASOUND MACHINE

1. Transducer
2. Pulser
3. Beam former
4. Receiver
5. Processor
6. Display
7. Digital storage
8. Hard copy printer devices.



# Basic Physics Behind Ultrasound

Ultrasound waves are also governed by physical laws that govern sound waves. US waves require a source for production. Also, as with sound waves, Ultrasound waves also require medium for travelling. The medium may be solid, liquid or gas. When striking a medium, some waves are reflected, some transmitted while others are refracted (See Figure). Higher frequency of US permits better spatial resolution but reduces the depth of penetration.




**US waves when striking a medium exhibit reflection and transmission. This may be decided by the property of the interface between the media**

# How are Ultrasond waves produced?

The working of ultrasound is based on piezoelectric effect, which was discovered by Curie brothers (Peirre and Jacques Curie) in 1880. First let us understand the meaning of piezoelectricity - the term is derived from the Greek work ***piezein***, which means to apply pressure. The effect is seen in quartz crystals that change shape when electricity is applied to them. This change of shape is very rapid and is associated with production of high frequency sound waves. The reverse phenomenon is also observed - the crystals also develop electric field on application of pressure. This allows the crystals both to emit sound waves as well to respond to them. This piezoelectric effect is at the heart of USG and is utilized in US probes to produce high frequency sound waves.