

SOUND AND HEARING (source: Keith Kelly, *Science*)

1. Match the beginnings of the sentences below with their endings;

Sound waves are longitudinal waves that can	vibrations per second and has units called hertz (Hz).
The loudness and softness of a sound	is measured in units called decibels (dB).
The loudness of a sound	depends on its amplitude.
The frequency of a sound is the number of	the impulse to the brain via the auditory nerve.
Sounds with irregular frequencies	which could lead to permanent deafness.
Sound waves are heard when they are transferred	are classified as noise.
The cochlea contains the sensory cells that transfer	through the structures in the ear to the cochlea.
Very loud sounds may rupture the eardrum	cause air molecules to compress and rarefy as they pass.

2. Read the text about sound ranges and fill in the gaps with appropriate words or phrases, then listen to the recording and check your answers;

Humans are usually able to hear sounds ranging between 1. _____.
 Animals, such as cats, bats and dogs are sensitive to sounds of
 2. _____. Sounds with frequencies exceeding the range normally
 heard by humans are often referred to as ultrasound. Although we cannot hear it, we
 have scientific instruments that use ultrasound for a wide range of important
 3. _____. Ultrasound is safer to use than 4. _____ when
 trying to "see" inside the body as it does not damage 5. _____, so we use it
 for: monitoring the growth and development of a 6. _____; detecting
 7. _____ (cancer) in the body; detecting brain damage.
 Sounds with frequencies below the normal range heard by humans are very
 8. _____ and are called infrasound. It is believed that some
 birds, such as pigeons, use infrasound for 9. _____. Infrasound has
 also important uses. For example, it is used to move air around in
 10. _____. At very high intensities, these
 low frequency sounds may cause 11. _____ to vibrate, which can
 result in 12. _____ such as nausea and internal injury.

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3. Loudness of sound

Put the phrases in the correct order to make sentences.

- 1 A ruler that and produces sound. at the edge of a table is flicked vibrates

- 2 by the ruler the distance moved up and down of the vibration. the amplitude We call

- 3 loud of a sound wave or soft. The amplitude the sound is whether will determine

- 4 a small amount of energy If is flicked only a little, is supplied the ruler then to the ruler.

- 5 a small amplitude a soft sound and causes in vibration is heard. This

- 6 and and a large energy However, if the ruler is larger is flicked more strongly,
is supplied, louder. the amplitude the sound will be

- 7 on the ruler, that occurs. The harder the louder the sound you pluck

- 8 a guitar. applies of on the strings The same to plucking

- 9 can be cycle graphically. of represented The complete the vibrations

- 10 A a amplitude. greater has louder sound

4. Frequency or pitch of sounds

Match the beginnings and endings of sentences.

Beginnings

- 1 Pitch is a musical term which is similar
- 2 The frequency of a sound represents the number
- 3 However the sensations of these frequencies are
- 4 Objects that vibrate more rapidly, that is have more vibrations per second,
- 5 So, on a guitar, the strings that produce notes with a higher pitch
- 6 The unit for frequency is

Endings

- a commonly referred to as the pitch of a sound.
- b cycles per second or hertz (Hz).
- c in meaning to the scientific term frequency.
- d of vibrations that occur in one second.
- e vibrate faster than those with a lower pitch.
- f will have a higher pitch than objects that vibrate more slowly.

1 2 3 4 5 6

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5. Read the text below and complete it with the phrases from A to H

- A. may have acted as primitive loudspeakers
- B. hushes low-frequency background noises like the murmur of a crowd
- C. was acting as a filter for sound waves at certain frequencies
- D. the low frequencies of speech were also filtered out to some extent
- E. makes the ancient amphitheater an acoustic marvel
- F. similar to the ridged acoustics padding on walls or insulation in a parking garage
- G. which may have played a large role in the gradual abandonment of Epidaurus' design
- H. well before any theater had the luxury of a sound system

As the ancient Greeks were placing the last few stones on the magnificent theater at Epidaurus in the fourth century B.C., they couldn't have known that they had unwittingly created a sophisticated acoustic filter. But when audiences in the back row were able to hear music and voices with amazing clarity (1. _____), the Greeks must have known that they had done something very right because they made many attempts to duplicate Epidaurus' design, but never with the same success.

Researchers at the Georgia Institute of Technology have pinpointed the elusive factor that 2. _____. It's not the slope, or the wind — it's the seats. The rows of limestone seats at Epidaurus form an efficient acoustics filter that 3. _____ and reflects the high-frequency noises of the performers on stage off the seats and back toward the seated audience member, carrying an actor's voice all the way to the back rows of the theater.

While many experts speculated on the possible causes for Epidaurus' acoustics, few guessed that the seats themselves were the secret of its acoustics success. There were theories that the site's wind — which blows primarily from the stage to the audience — was the cause, while others credited masks that 4. _____ or the rhythm of Greek speech. Other more technical theories took into account the slope of the seat rows.

When Declercq set out to solve the acoustic mystery, he too had the wrong idea about how Epidaurus carries performance sounds so well. He suspected that the corrugated, or ridged, material of the theater's limestone structure 5. _____, but he didn't anticipate how well it was controlling background noise.

"When I first tackled this problem, I thought that the effect of the splendid acoustics was due to surface waves climbing the theater with almost no damping," Declercq said. "While the voices of the performers were being carried, I didn't anticipate that 6. _____."

But as Declercq's team experimented with ultrasonic waves and numerical simulations of the theater's acoustics, they discovered that frequencies up to 500 Hz were held back while frequencies above 500 Hz were allowed to ring out. The corrugated surface of the seats was creating an effect 7. _____.

So, how did the audience hear the lower frequencies of an actor's voice if they were being suppressed with other background low frequencies? There's a simple answer, said Declercq. The human brain is capable of reconstructing the missing frequencies through a phenomenon called virtual pitch. Virtual pitch helps us appreciate the incomplete sound coming from small loudspeakers (in a laptop or a telephone), even though the low (bass) frequencies aren't generated by a small speaker.

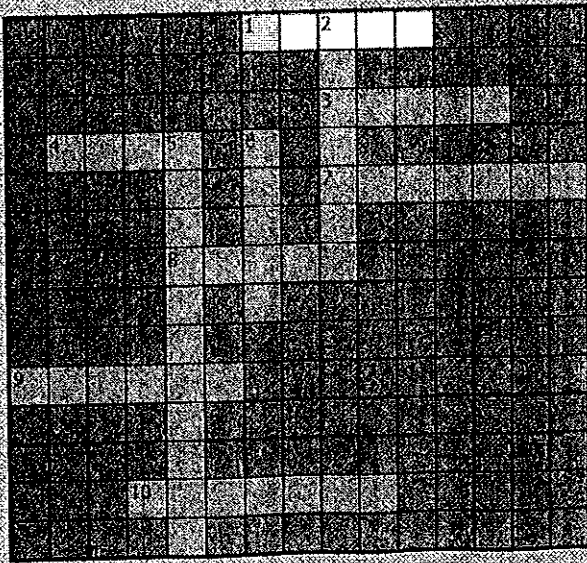
The Greeks' misunderstanding about the role the limestone seats played in Epidaurus' acoustics likely kept them from being able to duplicate the effect. Later theaters included different bench and seat materials, including wood, 8. _____ over the years by the Greeks and Romans, Declercq said.

<http://www.sciencedaily.com/releases/2007/04/070404162237.htm> accessed on March 18, 2015

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6. Complete the crossword.



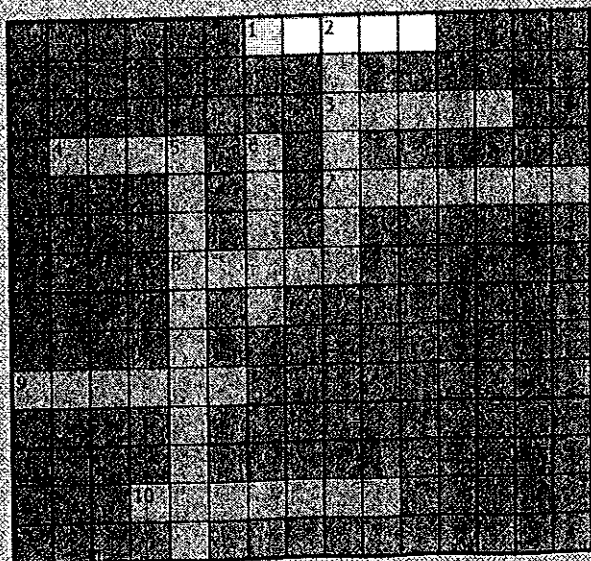
Across

1. a unit for measuring the frequency of sound waves and radio waves
3. the high or low quality of a sound that is controlled by the rate of the vibrations that produce it
4. stretched tight
7. a fluid-filled cavity in the inner ear that helps us keep our balance
8. any sound that has no regular pattern or frequency
9. the unpleasant noise that you hear on a radio, television, or telephone that is caused by electricity in the air
10. a unit for measuring how loud a sound is

Down

2. burst or tear suddenly
5. a piece of electronic equipment that is used for sending radio, television, or telephone signals through the air
6. a small bone in the middle ear between the hammer and the stirrup

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