Lesson 3 Sound

Skim *Lesson 3 in your book. Read the headings and look at the photos and illustrations. Identify three things you want to learn more about as you read the lesson. Record your ideas in your Science Journal.*

Main Idea

Details

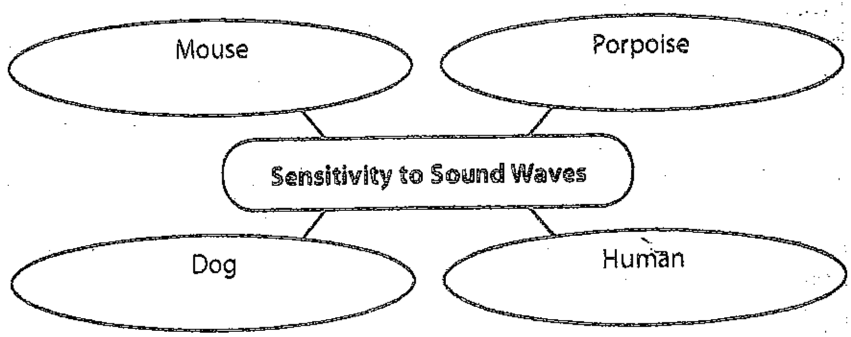
What are sound waves?
I found this on page ______.

Identify *three ways in which light waves and sound waves are different from each other.*

1. Light waves are electromagnetic; sound waves are ______________________.
2. We perceive light waves by seeing; we perceive sound waves by ______________________.
3. Light waves are transverse; sound waves are ______________________.

I found this on page ______.

Detail *sensitivity to sound waves. Write the range in Hz, and circle the animal with the most sensitive hearing.*



I found this on page ______.

Differentiate *regions of a longitudinal wave.*

Compression	Rarefaction

Properties of Sound Waves
I found this on page ______.

Relate *frequency and* pitch.

The higher the frequency of the waves, ______________________.

The lower the frequency of the waves, ______________________.

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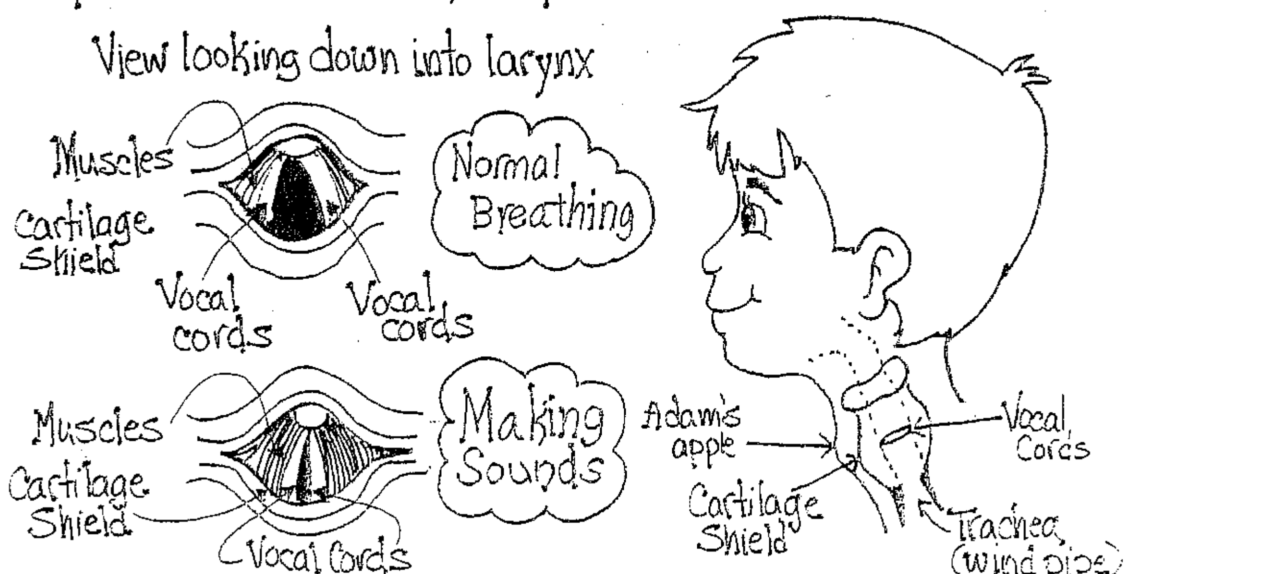
Voice Box

When you breathe normally, the air goes through your nose into your windpipe. The windpipe is a hollow tube leading from the back of your throat towards the lungs. At the top of the windpipe is a hollow organ called the voice box or larynx. It is made of bone and cartilage held together by ligaments and muscles.

The vocal cords in your voice box are two, straight, elastic-like strings. When you are not speaking or singing, these cords are relaxed against the sides of your voice box. When you start to talk or sing, tiny muscles bring the vocal cords closer together. Air coming up from the lungs makes the vocal cords move back and forth very fast (vibrate). When vocal cords vibrate, sounds are produced. Stretching the vocal cords tight and thin makes your voice high and squeaky. Relaxing them to a loose and wide shape makes low, deep sounds.

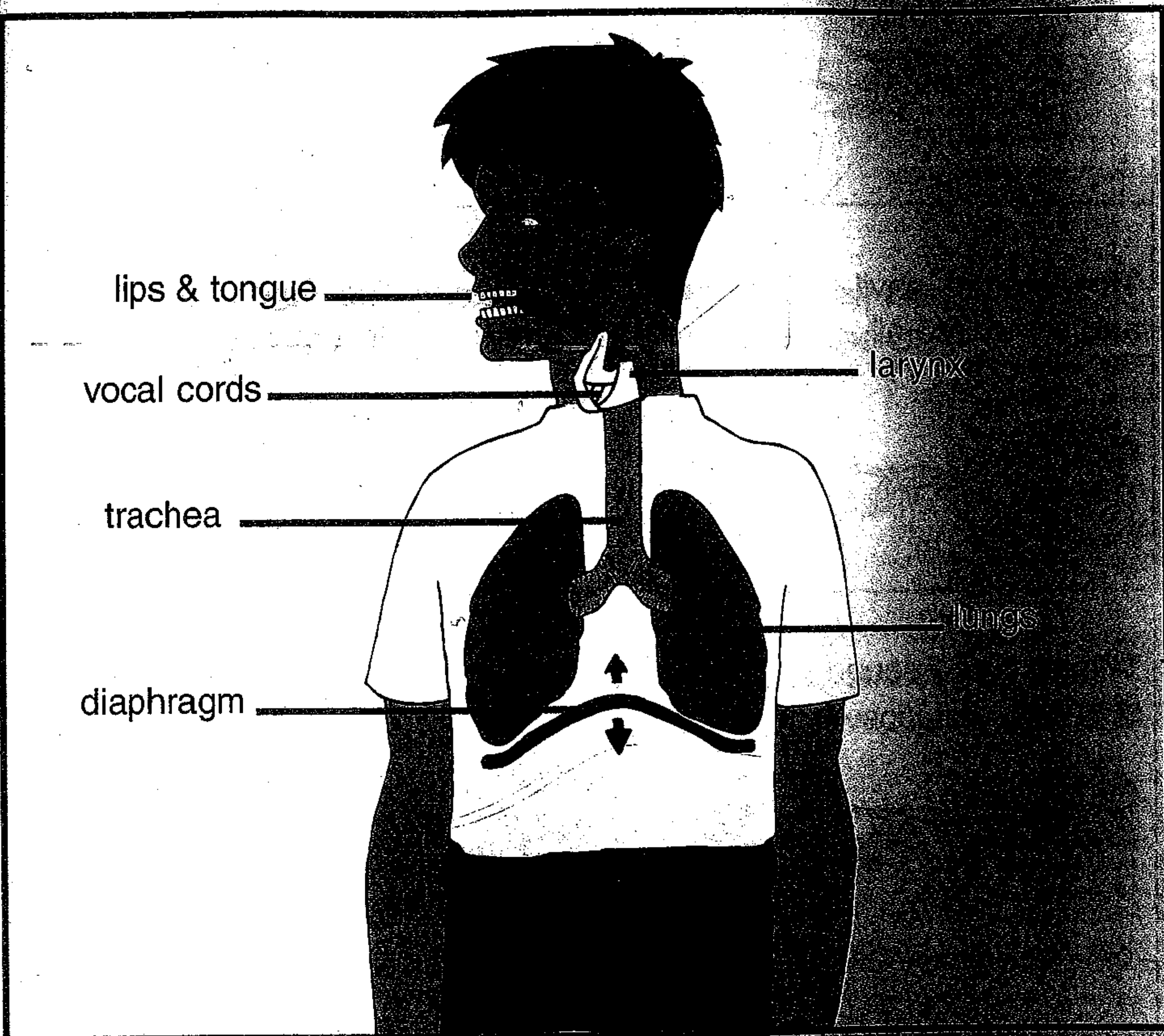


You can find your larynx just behind the bump in your throat called the Adam's apple. Feel around for the cartilage shield. The larynx is right behind it. *Put your hand on your larynx and hum or talk. Feel the vibrations. Make the lowest sound that you can. Now make the highest sound. Feel the muscles move.

 * Follow the directions. © 1994 AIMS Education Foundation

How People [redacted] Make Sounds

These are the parts of your body that you use to produce sounds and change those sounds into words.



The **lips** and **tongue** shape the sounds into words. The larynx contains and protects the **vocal cords.** When air passes over the vocal cords, they vibrate, making sounds. The **trachea** carries air through the larynx. The **lungs** hold enough air to make continuous sound. The diaphragm pushes up to force air out of the lungs.

ANSWER THE FOLLOWING QUESTIONS IN YOUR NOTEBOOK:

A. DEFINE THE FOLLOWING TERMS:

1. LARYNX
2. TRACHEA

B. DESCRIBE WHAT YOU FELT WHEN YOU PUT YOUR HAND ON YOUR LARYNX AND HUMMED OR TALKED.

C. WHAT DIFFERENCES DID YOU FEEL BETWEEN A LOW SOUND AND A HIGH SOUND?

D. HOW ARE GUITAR STRINGS AND THE HUMAN VOICE SIMILAR?

DANGEROUS DECIBELS SOUND COMPUTER ACTIVITY

http://dangerousdecibels.org/exhibit/virtual-exhibit/

- WHAT'S THAT SOUND?

WHICH SOUND IN THE FIRST SECTION (BABY, CAT, ETC) WAS THE MOST DIFFICULT FOR YOU TO HEAR?

WHY WAS THE SOUND HARD TO HEAR?

- **HOW DO WE HEAR?**

EXPLORE THE PARTS OF THE EAR. EXPLAIN THE FUNCTION OF THE "TYMPANIC MEMBRANE". WHAT IS THE TYMPANIC MEMBRANE MORE COMMONLY KNOWN AS?

WHAT IS THE IMPORTANCE OF A HAIR CELL? DRAW A HEALTHY CELL AND A DAMAGED HAIR CELL.

DESCRIBE HOW DAMAGED HAIR CELLS CAUSE HEARING LOSS.

- **HOW LOUD IS TOO LOUD?**

PLAY HOW LOUD IS TOO LOUD.

AT WHAT SOUND LEVEL (DECIBEL) MIGHT HEARING LOSS OCCUR?

- **<u>WHAT IS SOUND?</u>**

WHAT DOES A SOUND WAVE LOOK LIKE? DRAW ONE.

- **<u>MEASURING SOUND</u>**

HOW IS SOUND MEASURED?

WHAT IS THE DIFFERENCE BETWEEN AMPLITUDE AND FREQUENCY? WHAT ARE THE UNITS INVOLVED?

NORMAL SPEAKING VOICES ARE AROUND HOW MANY DECIBELS?

- **<u>ROCK YOUR WORLD</u>**

SEE IF YOU CAN MAKE THE RIGHT CHOICES TO PROTECT YOUR EARS.

WHAT BAD THINGS DO YOU DO TO YOUR OWN EARS BECAUSE YOU DIDN'T KNOW?

- **<u>WHADDYA KNOW?</u>**

TAKE THE QUIZ. WHAT IS YOUR SCORE?

STATION 4

Investigating Pitch using rulers

MATERIALS: Rulers

Extend one end of the ruler over the edge of the table and pluck it. Listen.

A. Predict whether the ruler will make low or high pitch sounds when a long piece of it extends over the edge of the table. Predict the sound produced by a medium and short piece of the ruler.

B. Now investigate the sounds produced by plucking different lengths of the ruler. Record what you hear.

C. What effect does the length of the ruler have on pitch?

D. What is the difference between pitch and volume?

E. Read "The Elephant's Rumble" as a group. Why can't we hear their rumble?

F. Define INFRASOUND and ULTRASOUND.

G. Why is ultrasound useful for dogs?

Reading Selection

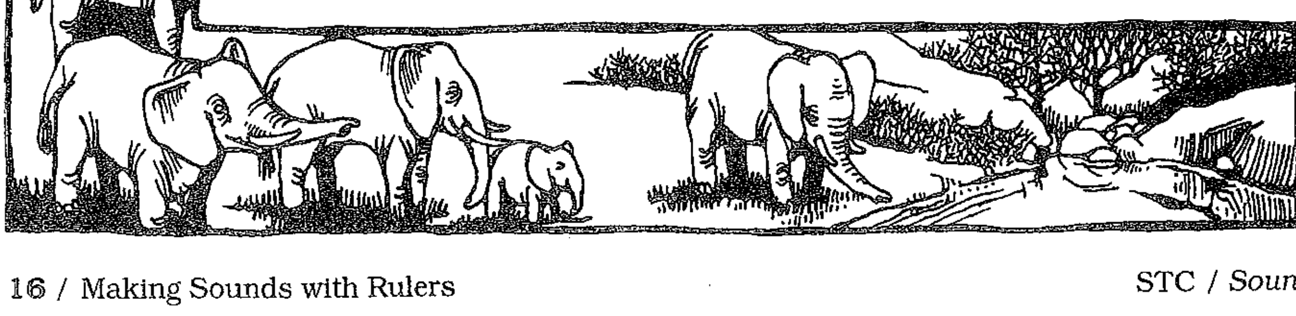
The Elephant's Rumble

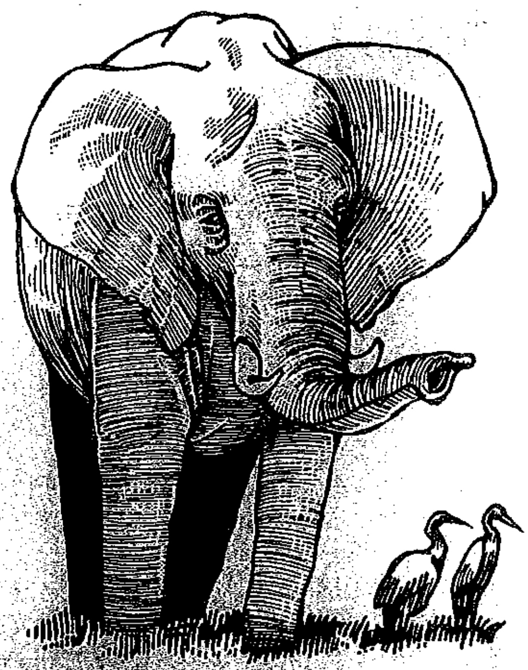
Sit quietly for a moment and listen to the sounds around you. What do you hear? Do you hear sounds made by people? Do you hear sounds made by machines? Do you hear any sounds made by animals—for example, the barking of dogs? What other sounds have you heard animals make? Have you heard the roar of a lion, the moo of a cow, the meow of a cat, the hoot of an owl, or the squeak of a hamster?

One sound that probably would not be on your list is the "elephant's rumble." You probably could not hear it even if you were standing right in the elephant house at the zoo. If an elephant made this sound, your human ears might hear a soft rumbling or you might hear nothing at all. Elephants, however, would hear this sound very clearly.

Elephants also make sounds that human ears *can* hear. They bellow. They make trumpeting sounds. Why, then, can't we hear their rumble? The rumble has a very low pitch. It is lower than the lowest pitch human ears can hear. ("Low" as it is used here does not mean "quiet." A low-pitched sound is a deep sound. An example would be the sound made by the horn of a tugboat.) When the elephant vibrates the air inside its trunk to make the rumbling sound, the pitch of the sound is *very, very* low. A special name is given to this kind of sound. It is **infrasound.** The word means "below sound."

No one knew about the elephant's rumble until quite recently. In the 1980s, a scientist named Katharine Payne discovered this sound and began to study it. Later, she wrote a book for young people about elephants and their rumble. In the book, *Elephants Calling,* she explains that



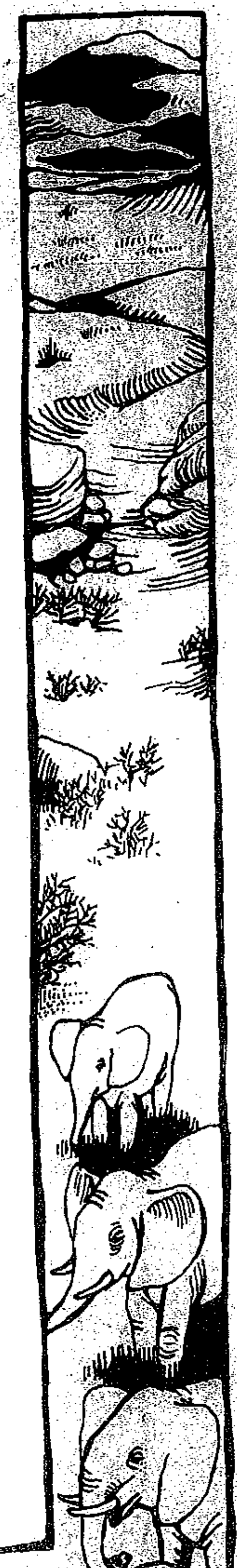


infrasound can travel much farther than most sounds that human ears can hear. Katharine Payne's studies showed that elephants use infrasound to send messages to other elephants that are miles away. She used special tape recorders to record these sounds that human ears cannot hear.

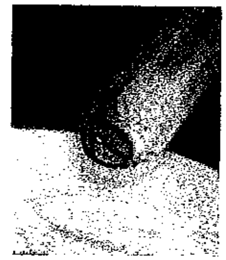
What kinds of messages are elephants sending each other over such long distances? According to Katharine Payne, they are giving and receiving important information. For example, their messages can help other elephants find the food and water they need.

The low rumbles of elephants can make the air vibrate, or throb, almost like the rumbling of distant thunder. If you can visit elephants at the zoo, notice whether you feel the air throbbing. If you do, maybe it is because the elephants are calling to each other with infrasound.

If infrasound is so *low* human ears cannot hear it, can you guess what ultrasound is? **Ultrasound** is at a *higher* pitch than what human ears can hear. The dog is one animal that can hear some high-pitched sounds which we cannot. In fact, there is a special kind of whistle made for dogs. If you blew one of these dog whistles, you would not hear a thing, but your dog would. So just as you would be considerate of human ears when blowing a whistle, remember to be considerate of dogs' ears when blowing a dog whistle!

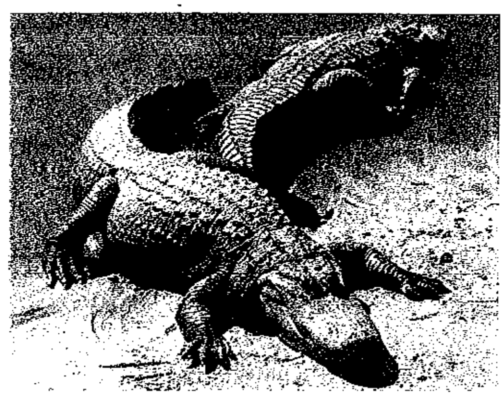


Infrasound



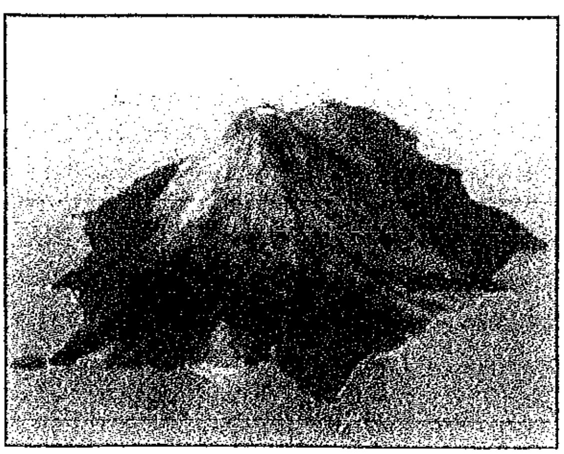
Our atmosphere is filled with sounds that we cannot hear. The Earth hums; volcanoes howl, pop and whistle; storms roar menacingly; and meteors scream before exploding high above the ground. We do not know these sounds are happening because they take place at frequencies below the lower limit of human hearing, otherwise known as infrasound.

Infrasound can travel distances of several thousand kilometres.



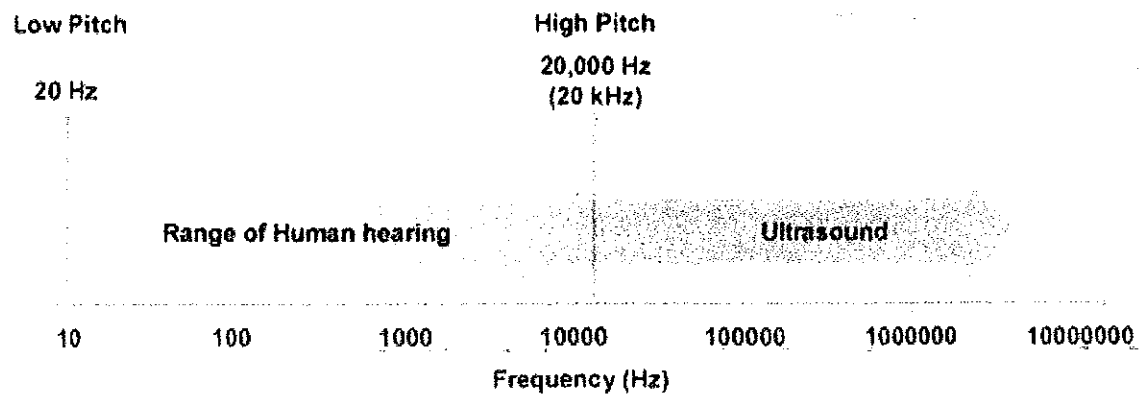
Whales, elephants, hippopotamus, rhinoceros, giraffes, and alligators are known to use infrasound to communicate over distances—up to hundreds of miles in the case of whales.

The Indonesian volcano Krakatoa in 1883 showed scientists that what we can hear is just a narrow slice of the full sound spectrum. This eruption generated the loudest recorded sound in history, and was distinctly heard some 4800km away on the island of Mauritius. Barometers, sensitive to very small changes in air pressure, recorded the devastating event.



Ultrasound

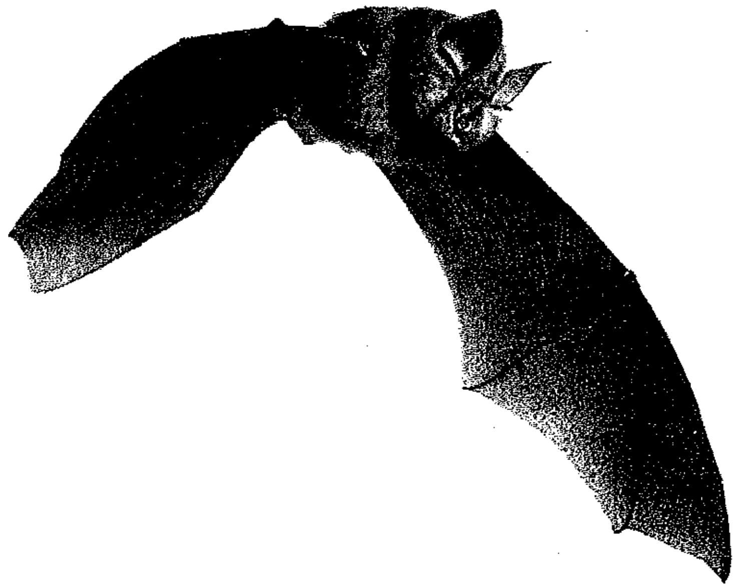
The normal range of human hearing is between about 20Hz and 20kHz, but the range becomes less as we get older. Sounds with frequencies above about 20kHz are called ultrasound.



Ultrasound travels freely through fluid and soft tissues but is reflected back (it bounces back as 'echoes') when it hits a more solid (dense) surface. As ultrasound hits different structures in the body of different density, it sends back echoes of varying strength.

Computers are able to create detailed images by combining many ultrasound reflection readings. This is used in medicine for checking unborn babies.

Bats

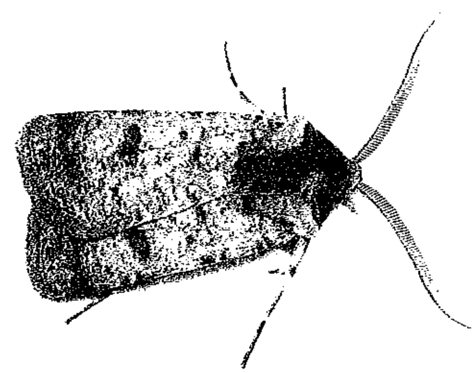


By emitting high-pitched sounds and listening to the echoes, also known as sonar, bats locate prey and other nearby objects. This is the process of echolocation, an ability they share with dolphins and whales.

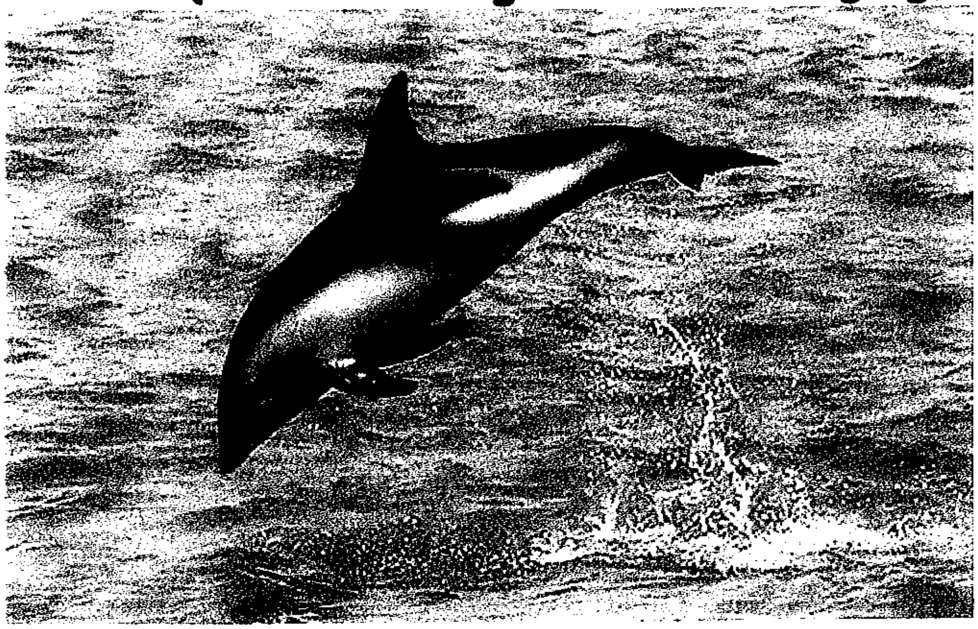
Two groups of moths exploit the bats' senses:

Tiger moths produce ultrasonic signals to warn the bats that the moths are distasteful or poisonous.
Upon detection of a bat's target acquisition signal, the moth can also take immediate evasive action by tailspinning.

The moths Noctuidae have a hearing organ called a tympanum which responds to an incoming bat signal by causing the moth's flight muscles to twitch erratically, sending the moth into random evasive manoeuvres.

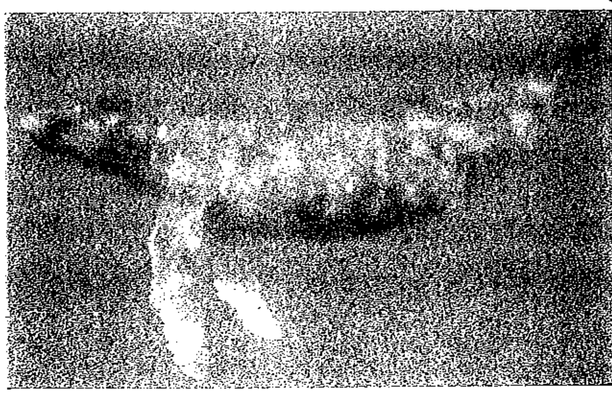


Sonar (SOund NAvigation and Ranging)



Dolphins can produce high pitched clicks. When these clicks hit an object, some of the sound will echo back to the "sender". By listening to the echo and interpreting the time it took before the echo came back, the dolphin estimates the distance of the object.

Whale Song



Whale songs consist of distinct sequences of groans, moans, roars, sighs and high pitched squeals that may last up to 10 minutes or longer. All the males in the population sing the same song using the same sounds arranged in the same pattern. Over time, however, this pattern changes, but all the singers make the same changes to their songs. After a few years the song may be quite different, but all the singers are still singing the same new song.

Hands-on Activity: Echolocation in Action!

In this activity, you will experience echolocation yourself. You will actually try echolocation by wearing blindfolds while another student makes snapping noises in front of, behind, or to the side of you.

Engineering Connection

We need to know where things are, and many times we need to be able to "see" something even when it's dark outside or something is far away and obstructed by the ocean or clouds. Engineers have learned from nature how to use sound and radio waves to locate objects. This is called SONAR (SOund wave Navigation And Ranging) and RADAR (RAdio wave navigation And Ranging).

Introduction/Motivation

We have been talking about sound waves and how animals and engineers use sound waves to "see" underwater or in the dark. Who remembers what it is called when animals do this? (Answer: echolocation) That's right — *echolocation*! Engineers developed a technology based on the natural echolocation that animals use. It works pretty much the same way, but we call it something different. Who remembers what it is called? (Answer: SONAR) Terrific! *SONAR* is a great example of how engineers can learn from the world around us and use ideas from nature to create new ways to help people.

Today you are going to have a chance to try out echolocation for yourselves. You are going to break up into teams of two. Then, one person closes their eyes and guesses where the sound is coming from as the other person makes snapping or clapping noises in front of them, behind them or to their side. It is a fun challenge to learn about echolocation. Are you ready to try it out? Let's get started!

Procedure

Background

Sound travels in waves through the air to the ears. Depending on the location and intensity of the sound, the ear can usually locate the direction of the sound.

Animals — such as bats, whales and dolphins — use sound to see by emitting sounds that echo off other objects and then return to their ears. Depending on how long it takes the sound to reach their ears and the direction it comes from, these animals can determine the location of the object.

Engineers have mimicked this natural echolocation in Sonar and Radar, which work basically the same way as echolocation in animals.

In this activity, students will try to determine the location of nine sounds made from various locations in front of, behind or to the side of them. Try to spread students out as much as possible so that each team can focus on their own clapping or snapping noises without being distracted by other teams.

1. One person should close their eyes so that they are unable to see. No peeking!
2. The other person should snap or clap their fingers while the other student guesses the location from where the snap came.
3. Students should record their partner's response on the Echolocation Worksheet after each snap/clap.
4. Students should put a check mark if their partner guessed correctly and an X if they guessed incorrectly.
5. Write down the number of times they guessed correctly for each location (side, behind or in front).
6. Switch places and repeat the procedures. Once both students have guessed, give each other their worksheets, so they can use them to create their own bar graphs.
7. Color in theiEcholocation Bar Graph Worksheet with the number of times that you guessed correctly for each location.

→ ## Investigating Questions

- How does Sonar work?
- How does ultrasound work?
- Research using the ~~textbook~~. handouts

→ Write the answers to the Investigating Questions in your Notebook.

→ Staple your Echolocation Bar Graph worksheet in your notebook.

Name: ______________________________ Date: ______________

Echolocation in Action! Activity – Echolocation Worksheet

Recorder (team partner): ______________________________

Location	Actual Guess	Right?	Wrong?
Front			
Behind			
Side			
Side			
Behind			
Front			
Front			
Behind			
Side			

Number of times the "front" guess was right: _________

Number of times the "side" guess was right: _________

Number of times the "behind" guess was right: _________

Name: ______________________________ Date: ______________

Echolocation in Action! Activity – Echolocation Bar Graph Worksheet

Number of times the "front" guess was right: ________
Number of times the "side" guess was right: ________
Number of times the "behind" guess was right: ________

Color in the bar graph below with the number of times each guess was right. If the answer is 0, leave that group blank.

3			
2			
1			
	Front	Side	Behind

Which location had the most correct guesses? (If it was a tie, you can write both locations). ______________________________

Which location had the least correct guesses? ______________

What are your ideas about why some locations were easier or harder to guess?

____

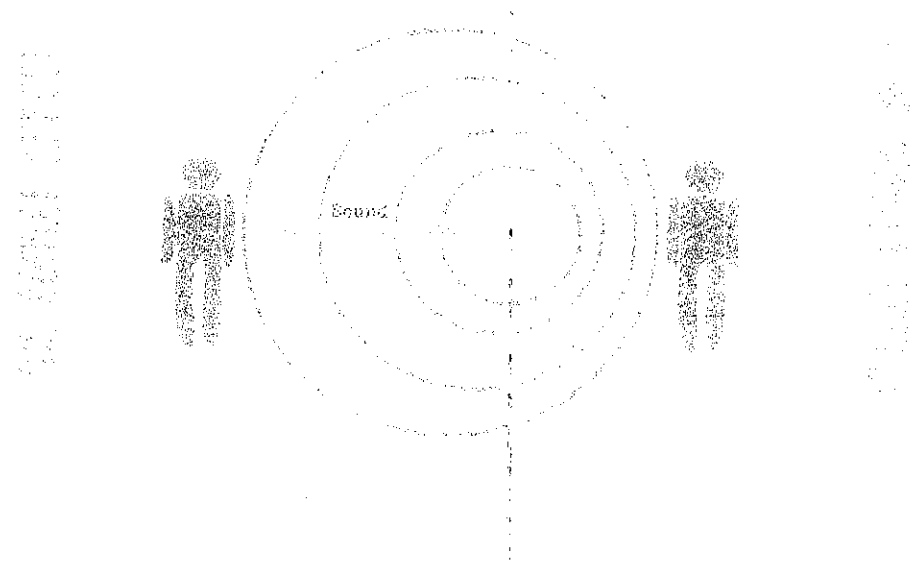
____

Moving Sound: The Doppler Effect

Ever notice how sound changes and warps as it gets nearer or farther away? For instance, as a train comes closer the sound is high pitched, and it increases in pitch until it passes you. Then when it passes the pitch drops very quickly. This is called the Doppler effect.

WHAT'S HAPPENING?

The Doppler effect happens because the air in front of a moving object is compressed. That means the air particles are closer together, so the sound waves are closer together and create a high pitched frequency. The air behind a moving object is not compressed.



STATION 6

Exploring with Tuning Forks

MATERIALS: Tuning forks
Rubber striking block

A. Strike the prongs of one tuning fork gently against the striking block and then hold the fork close to your ear. What do you hear?

B. What happens when you touch the prongs of the fork? Why?

C. Strike the prongs of one tuning fork gently against the striking block and then hold the fork close to your ear. Strike the same tuning fork a little harder and listen. How do the sounds differ? Why?

D. Does the pitch of the sounds change with different tuning forks? If so, explain why the pitch changed.

E. Doppler Effect: Strike a tuning fork and hold it at an arm's length in front of you. Rapidly bring the tuning fork toward your ear then away again. How does the pitch of the sound change as the tuning fork approaches your ear?

F. Read about the Doppler effect as a group.

G. How does the Doppler Effect explain the change in pitch of a moving source of sound?

Name ______________________ Date ______________ Class __________

Key Terms

Use the clues to help you unscramble the key terms from the chapter. Then put the numbered letters in order to find the answer to the riddle.

Clues	Key Terms	
The membrane that separates the outer ear from the middle ear	mrrudae	___(1) ___ ___ ___ ___ ___ ___
The cavity filled with fluid in the inner ear	ccleoah	___(2) ___ ___ ___ ___ ___ ___
How high or low a sound seems to a person	hctip	___ ___ ___ ___ ___(3)
Sound waves with frequencies above the normal human range of hearing	dnuosartlu	___ ___ ___ ___ ___ ___ ___(4) ___ ___ ___
The ability of a material to bounce back after being disturbed	ttiiscyale	___ ___(5) ___ ___ ___ ___ ___ ___ ___ ___
System that uses reflected sound waves to detect and locate objects underwater	noars	___ ___(6) ___ ___ ___
How well sounds can be heard in a particular room or hall	ccuossiat	___ ___ ___ ___ ___ ___ ___ ___(7) ___
Your voice box	xyarnl	___ ___(8) ___ ___ ___ ___
A natural frequency of an object that is higher than the fundamental tone	vneeroot	___ ___ ___ ___ ___(9) ___ ___ ___
Sound with a pleasing quality	smcui	___ ___ ___ ___(10) ___
A reflected sound wave	choe	___ ___ ___ ___(11)
The amount of energy a sound wave carries per second through a unit area	ynittiens	___ ___ ___ ___ ___(12) ___ ___ ___ ___

Riddle: What is the use of sound to find distance?

Answer: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
1 2 3 4 5 6 7 8 9 10 11 12

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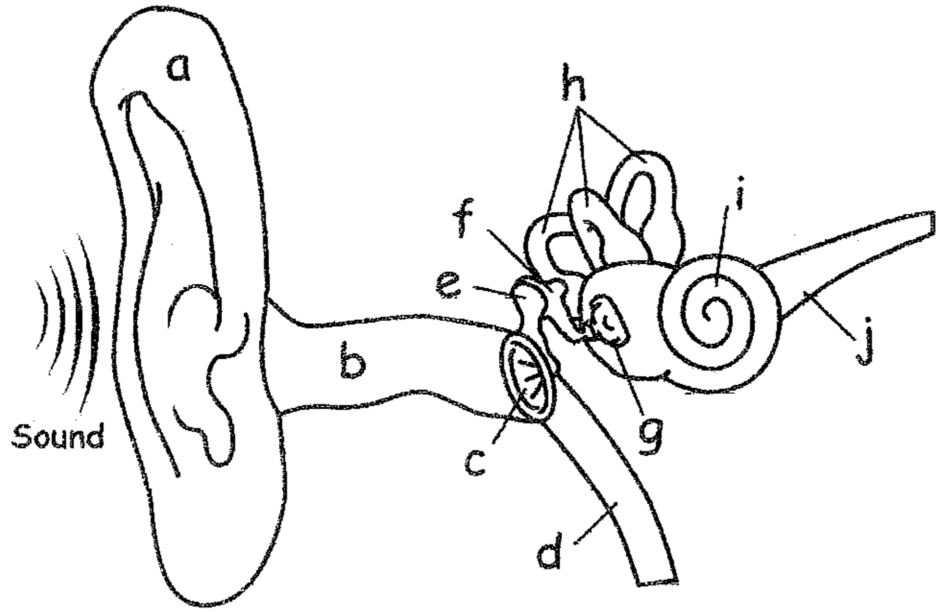
ACTIVITY PAGE

Name________________________ **Date**________ **Class**________

What's In Your Ear?

Listen up! Your ear is an amazing acoustic instrument. It's designed to hear all kinds of sounds, from loud thunderclaps to quiet whispers. Find out how it works by coloring in its parts with crayons, colored pencils, or colored markers.

a. Outer ear (pink)
b. Ear canal (orange)
c. Ear drum (blue)
d. Eustachian tube (gray)
e. Malleus (purple)
f. Incus (red)
g. Stapes (black)
h. Semicircular canals (green)
i. Cochlea (white)
j. Auditory nerve (yellow)



Outer ear--the outside part that you can see and touch. Helps to funnel the sound towards inside.

Ear canal--A tube that filters and focuses sound.

Ear drum--A thin sheet of tissue that vibrates when sound hits it.

Eustachian tube--A tube that connects the ear to the throat, so that pressure doesn't damage the ear.

Malleus--One of three tiny bones that helps to turn sound into electrical signals.

Incus--One of three tiny bones that helps to turn sound into electrical signals.

Stapes--One of three tiny bones that helps to turn sound into electrical signals.

Semicircular canals--Fluid-filled tubes that help you maintain your balance.

Cochlea--The main organ of hearing, a tiny fluid-filled spiral of neurons.

Auditory nerve--Relays electrical signals from the ear to the brain.

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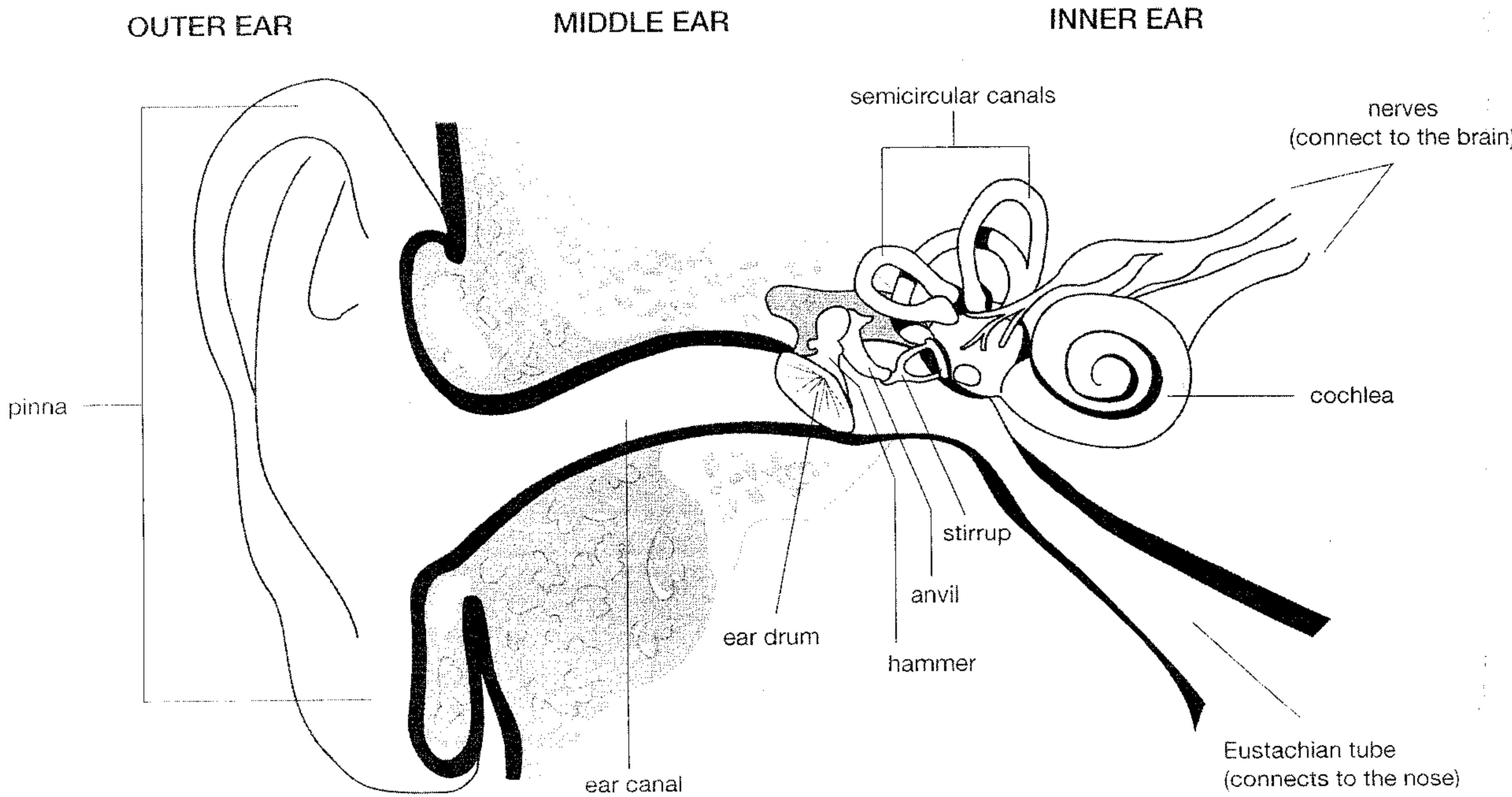
The Human Ear

Directions: Color in the diagram below using a different color for each part of the ear.



Protect your ears. If the noise is too loud, walk away, turn it down (*Turn it to the Left*), or use ear plugs.

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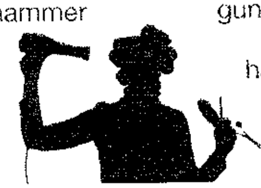
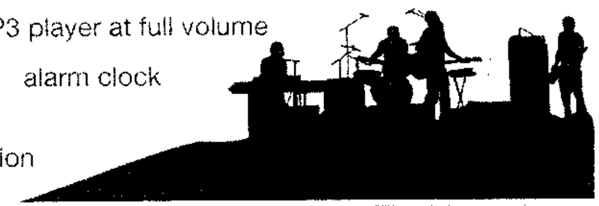
Noise Levels





traffic
snowmobile
leaves rustling
lawn mower
dishwasher
custom car stereo at full volume
vacuum cleaner
jackhammer
gun shot
hair dryer
whisper
jet plane takeoff
fireworks
ambulance
sporting event
quiet library
power tool
normal conversation
MP3 player at full volume
alarm clock
car horn
moderate rainfall
blender
live concert

FAINT 20–30 dB	SOFT 30–50 dB	MODERATE 50–70 dB		VERY LOUD 90–120 dB	UNCOMFORTABLE 120–130 dB	PAINFUL & DANGEROUS 130+ dB

Protect your ears. If the noise is too loud, walk away, turn it down (*turn it to the Left*), or use ear plugs.

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