Sound

Teacher's Guide
Grades 5-9

Editors:
Brian A. Jerome, Ph.D.
Stephanie Zak Jerome

Assistant Editors:
Heidi Berry
Stephanie Rogers
Anneliese Brown

Visual Learning Company
Brandon, Vermont
1-800-453-8481
www.visuallearningco.com

Reviewers:

Reviewers:
Linda Arnone
Clark County Public School
Las Vegas, Nevada

Steve Welch
Rutland Middle School
Rutland, Vermont

John Peterson
Professor Emeritus of Physics
Providence, Rhode Island

Use and Copyright:

081900

Viewing Clearances

The video and accompanying teacher's guide are for instructional use only. In showing these programs, no admission charges are to be incurred. The programs are to be utilized in face-to-face classroom instructional settings, library settings, or similar instructional settings.

Duplication rights are available, but must be negotiated with the *Visual Learning Company.*

Television, cable or satellite rights are also available, but must be negotiated with the *Visual Learning Company*.

Closed circuit rights are available, and are defined as the use of the program beyond a single classroom but within a single campus. Institutions that wish to utilize the program in multiple campuses must purchase the multiple campus version of the program, available at a slightly higher fee.

Discounts may be granted to institutions interested in purchasing programs in large quantities. These discounts may be negotiated with the *Visual Learning Company.*

Table of Contents

A Message from our Company . . .

Dear Educator:

Thank you for your interest in the educational videos produced by the *Visual Learning Company*. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary school teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome

National Standards Correlations

National Science Education Standards

(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Science as Inquiry - Content Standard A:

As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Physical Science - Content Standard B:

As a result of their activities in grades 5-8, all students should develop an understanding of how:

- Waves, including sound, have energy and can transfer energy when they interact with matter.

Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - Motion (4F)

By the end of the 8th grade, students should know that:

- Something can be "seen" when light waves emitted or reflected by it enter the eye, just as something can be "heard" when sound waves from it enter the ear.
- Vibrations in materials set up wavelike disturbances that spread away from the source. Sound and earthquake waves are examples. These and other waves move at different speeds in different materials.

Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students should be able to do the following:

- Understand that sound waves must travel through a medium;
- Comprehend that sound waves are longitudinal waves, which travel parallel to the direction of the wave;
- Identify the three main factors that affect the speed of sound: temperature, elasticity and density;
- Differentiate between ultrasonic sound waves and infrasonic sound waves;
- Understand the concept of the Doppler Effect and provide an example;
- Explain how the pitch of a sound depends upon the frequency of a sound wave;
- Understand that the more energy that goes into a sound wave, the louder the sound intensity; and
- Identify the different types of interactions between sound waves, including destructive interference and constructive interference.

Assessment

Preliminary Test:

The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled "You Decide" that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.

Introducing the Video

Define the term *sound* as a class. Divide the students into small groups. Ask the students to think about the different types of sounds they hear. Remind them to consider both pleasant sounds and unpleasant sounds. What are some characteristics of these sounds? Are they soft or loud? Are they high or low? Have one representative from each group write the sounds with their characteristics on the chalkboard. Allow the list to remain on the chalkboard while watching the video. After the completion of the program, refer to the examples on the chalkboard, and as a class, use the new terms that were mentioned in the video to help explain the different characteristics of sound.

Video Viewing Suggestions

You may want to photocopy and distribute the Student Master, "Video Review." You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question Video Quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may decide to either grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason, you may want to periodically stop the video to review and discuss new terminology and concepts.

Student Assessments and Activities

Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

Student Activity Masters:

- A Sound Journey
- Homemade Music
- Seeing Sound
- Whales and Sound
- Vocabulary of *Sound*

Video Script- Sound

1. What do these different scenes have in common?
2. These cars in busy traffic,...
3. ...this band playing music,...
4. ...these waves crashing on the beach,...
5. ...this dog barking,...
6. ...this fish finder,...
7. ...and this crowd of people?
8. They are all producing sound waves.
9. During the next few minutes we are going to explore some of the different characteristics of sound...
10. ... and see how sound affects our daily lives.
11. **Graphic Transition - What is Sound?**
12. Have you ever been in traffic behind a car with music playing so loud that you can feel the vibrations?
13. Ever noticed what happens when you hit a drum ...
14. ...or hammer a nail?
15. All these activities produce vibrations.
16. Sound is the result of the vibration of matter.
17. Most of the sounds we hear travel through air.
18. But sound can also travel through liquids or solids.
19. For example, put your ear against a door and have someone scratch the bottom of the door.
20. You can hear the scratching through the door. This demonstrates sound traveling through a solid.
21. You Decide! Can you hear music on the moon?
22. No, sound requires a medium, such as a solid, liquid or gas through which to travel.
23. On the moon or in space, there is little or no atmosphere, and thus no medium through which to carry sound.
24. **Graphic Transition - The Traveling of Sound**
25. We have learned that vibrations produce sound and that sound must travel through a medium, but how is sound transmitted?
26. Sound is a form of energy and is transmitted in the form of waves.
27. Sound waves are also called longitudinal waves.
28. In longitudinal waves, molecules move in a direction that is parallel to the direction of the wave.
29. This slinky demonstrates the movement of longitudinal waves.
30. The areas where the rings of the slinky are pushed together, or compressed, are called compression areas,...

Script

31. ...and the areas where the rings of the slinky are spread apart are called rarefaction areas.
32. The distance between two consecutive compressions or between two consecutive rarefactions is the wavelength.
33. **Graphic Transition - Speed of Sound**
34. You Decide – Do thunder and lightning occur at the same time?
35. That's right, thunder and lightning do occur at the same time.
36. Even though we see the flash of light before we hear the roar of thunder, they originate at nearly the same time. This is because light travels faster than sound.
37. In fact, you can estimate how far away a storm is by calculating how long it takes to hear the thunder after you see the lightning. There is about a three second delay for each kilometer between flash and thunder or about a 5 second delay per mile.
38. Light travels over 800,000 times faster than sound!
39. **Graphic Transition – Temperature and the Speed of Sound**
40. Now let's take a look at some of the factors that influence the speed of sound.
41. Listen to this band play.
42. The sounds produced by each instrument reach our ears at the same speed.
43. This is because the sound waves from each instrument are traveling at the same speed.
44. The speed at which sound waves travel is dependent upon the medium through which they are traveling, not the source of the sound.
45. Sound waves travel faster in warm air than they do in cold air
46. This is because molecules move faster at higher temperatures.
47. For example, on a winter day when the temperature is 0 degrees Celsius, sound travels at about 331 meters per second.
48. On a summer day when the temperature is 25 degrees Celsius, sound travels at about 346 meters per second.
49. That's quite a bit faster!
50. Temperature, however, is not the only factor that affects the speed of sound.
51. **Graphic Transition – Elasticity, Density, and the Speed of Sound**
52. While most of the sounds we hear travel through the air, sound can also travel through other mediums, such as solids.
53. You decide! Through which medium does sound travel faster: solid, liquid or gas?
54. Sound travels fastest through solids.
55. For example, sound can travel quite quickly through the ground.
57. Generally speaking, sound travels faster through solids than through liquids, and slowest through gases.
58. Sound waves travel fastest in solids because solids have more elasticity.
59. In matter with high elasticity, particles travel quickly back to their original positions after being distributed.
60. Liquids and gases are less elastic, making it more difficult for sound to travel through them. Therefore, sound travels more slowly through these mediums.

Script

61. When considering the speed of sound in matter of the same medium, density can play a big role.
62. For example, in solids, sound generally travels slower in denser metals such as lead, than it does in less dense materials such as aluminum.
63. This is because lead is less elastic than aluminum.
64. **Graphic Transition – Loudness and Intensity**
65. We just explained why sound travels at different speeds, but why does the loudness of sound vary,...
66. ...such as the difference between this loud music,...
67. ...and this flowing stream?
68. The different levels of sound we hear depend upon the amount of energy in the sound wave.
69. For example, a louder sound is produced when a door is slammed hard…
70. …than when a door is closed gently.
71. The harder this baseball player swings his bat, the louder the sound of the crack when he hits the ball.
72. The intensity of sound or loudness is measured in units called decibels.
73. The sound level of a chain saw is 90-110 dB's,...
74. ...whereas the sound of falling leaves is around 10 decibels.
75. Sounds that are greater than 120 decibels can cause ear damage and permanent hearing loss, which is why this worker is wearing ear protection.
76. **Graphic Transition – Pitch and Frequency**
77. The frequency of a sound wave can also cause sounds to differ from one another.
78. For example, the sound produced by this sheep is different than the sound produced by this gull.
79. These animals make sounds that have different tones.
80. The difference in tone is due to something called pitch.
81. Pitch can be illustrated by listening to the different octaves on this piano.
82. This key has a high pitch, and this key has a low pitch.
83. Pitch depends upon the frequency of a sound wave.
84. Remember that frequency is the number of waves that pass a point in a given time.
85. Sound waves with a high pitch, like this siren, have a high frequency...
86. ...and sounds with a low pitch, like thunder, have a low frequency.
87. Frequency is measured in units called hertz (Hz), which are the number of vibrations per second. One hertz equals one wave per second.
88. On average, the human ear is capable of detecting sounds with frequencies between 20 hertz and 20,000 hertz.
89. Some animals, such as dogs, can detect sounds above the human hearing range of 20,000 hertz.
90. Sounds above 20,000 hertz are called ultrasonic sounds.
91. We use ultrasonic sound waves in a system called Sound Navigation

Script

Ranging, or sonar.

92. This boat uses sonar to detect the depth of the ocean floor illustrated on this display screen.
93. Sonar can be used to locate fish in a lake with this fish finder.
94. Sound waves with frequencies below the human hearing range of 20 hertz are called infrasonic waves.
95. We produce infrasonic waves. For example, when you swing your arms back and forth a low frequency sound is produced, but your ears cannot hear the sound.
96. **Graphic Transition – The Doppler Effect**
97. We have discussed how the frequencies of waves change the pitch of a sound. Now let's take a look at what happens when the frequency and pitch change.
98. You decide! What happens to the sound of a train as it passes by you?
99. As the train approaches, the frequency of the sound increases and then decreases as it moves away.
100. Notice how the pitch of this car horn changes as it passes by. As it approaches, the pitch and frequency increases, but when it goes by, the pitch and frequency decrease.
101. This is the Doppler Effect.
102. The Doppler Effect is defined as a change in the frequency and pitch of a sound that is caused by movement in the source of the sound or the listener.
103. **Graphic Transition – Quality of Sound**
104. Compare the sound of these fingernails on this chalkboard,...
105. ...to the sound of this music.
106. Which would you say is a more pleasing sound?
107. The quality of sound or timbre depends upon the blending of different pitches in different frequencies of sound waves.
108. Music has a pleasing quality, unlike the sound of this construction equipment.
109. We refer to sounds that do not have a pleasing quality as noise.
110. Noise pollution occurs when there are so many unpleasant sounds that it becomes stressful to us.
111. Sound quality depends upon the interactions of sound waves.
112. **Graphic Transition – Interactions of Sound Waves**
113. Sound waves can interact in many different ways.
114. You Decide! What allows you to hear a conversation in another room even though you can't see the people?
115. The bending of sound waves around an object is called diffraction. For example, you can hear a car horn around the corner of this building.
116. Sound waves can also experience refraction.
117. When a wave travels into a medium of a different temperature or density, the wave changes direction. This is called refraction. For example, when sound waves

Script

called seismic waves travel through materials in the earth that have different densities, the waves bend or refract.

118. Another interaction of sound waves that affect the sounds we hear is called interference.
119. There are two types of sound interference: destructive and constructive.
120. In destructive interference, the compression of one wave encounters the rarefaction of another wave, and they cancel each other.
121. In destructive interference, the intensity of the sound is decreased.
122. In constructive interference, the compression of one wave overlaps or combines with the compression of a second wave.
123. The result of constructive interference is an increase in sound intensity.
124. **Graphic Transition – Summing Up**
125. During the past few minutes we have taken a look at the many different characteristics of sound.
126. We have discussed the speed of sound and…
127. …some of the factors that affect the speed of sound, including temperature,…
128. …elasticity, …
129. …and density of the medium through which sound travels.
130. We also explored characteristics of sounds with different loudness.
131. We studied pitch and…
132. …frequency,…
133. …and explored their roles in The Doppler Effect.
134. Finally, we explored some of the different interactions of sound.
135. So the next time you play an instrument,
136. …hear a loud noise,...
137. …or listen to some music,…
138. …think about some of the different characteristics of sound. You might just think about sound a little differently.

Video Quiz: Fill in the correct word when you hear this tone. Good luck, and let's get started.

1. The intensity of sound, or loudness, is measured in units called _______________.
2. Sounds waves with frequencies greater than 20,000 hertz are called _____________.
3. When movement changes the frequency and pitch of a sound, you experience ______.
4. __________ occurs when too many unpleasant sounds put too much stress on the human ear.
5. Destructive interference causes sound intensity to ____________.
6. The term used to describe waves that bend around objects is called _____________.
7. Sound travels _________on warmer days than on cooler days.
8. ________ is a result of a vibration of matter
9. Sound waves travel ________than light waves.
10. In a longitudinal wave, sound waves move __________ to the direction of a wave.

Answers to Student Assessments

Preliminary Test

1. Doppler Effect
2. diffraction
3. sound
4. speed of sound
5. hertz
6. frequency
7. energy
8. temperature
9. timbre
10. noise
11. false
12. false
13. false
14. false
15. true
16. true
17. false
18. true
19. true
20. false

Video Review

You Decide:

A. No, sound requires a medium to travel through and the moon has very little medium.
B. Yes, but you see lightning before you hear thunder because light travels faster than sound.
C. Sound travels fastest through solids.
D. The pitch and frequency of the train's sound changes due to the Doppler Effect.
E. diffraction

Video Quiz:

1. decibels
2. ultrasonic
3. Doppler Effect
4. noise pollution
5. decrease
6. diffraction
7. faster
8. sound
9. slower
10. parallel

Post Test

1. false
2. false
3. false
4. true
5. true
6. true
7. false
8. false
9. true
10. false
11. speed of sound
12. sound
13. temperature
14. noise
15. hertz
16. energy
17. Doppler Effect
18. timbre
19. diffraction
20. frequency

Answers to Student Activities

Sound Journey

Part A:
1. ear canal
2. ear drum
3. hammer
4. anvil
5. stirrup
6. oval window
7. semicircular canal
8. auditory nerve
9. cochlea

Part B:
1. ear canal
2. inner ear
3. anvil
4. auditory nerve
5. oval window
6. outer ear
7. hammer
8. semicircular canal
9. cochlea
10. stirrup
11. middle ear
12. ear drum

Hidden Message: CAN YOU HEAR ME?

Musical Bottles

Conclusion:
The bottle containing the most liquid will produce the highest sound. The bottle containing the least liquid will produce the lowest sound. A high pitch produces a high frequency and a low pitch produces a low frequency. The water temperature does not cause a difference in the pitch of the sound. A thin rubber band will vibrate faster than a thick rubber band and because of this, will have a higher frequency. A thin rubber band will have a high sound while a thick rubber band will have a low sound. If a rubber band does not produce a sound it is because the frequency being produced is not within the range of human hearing (25 hertz to 20,000 hertz).

Seeing Sound

Conclusion: When the tuning fork is hit against an object, it vibrates and produces a humming sound. The vibration is most visible when the tuning fork is in the water. Like sound waves that travel through air and cause your ear drum to vibrate, the fork vibrates the water, causing it to splash.

Whales and Sound

Part I
1. D
2. B
3. D
4. C

Part II
1. F
2. T
3. T
4. F
5. F

Part III
Students' essays will vary.

Vocabulary

1. frequency, j
2. pitch, g
3. hertz, i
4. infrasonic, a
5. Doppler Effect, b
6. refraction, k
7. destructive interference, d
8. constructive interference, c
9. diffraction, e
10. noise pollution, h
11. ultrasonic, f

Assessment and Student Activity Masters

Name________________

Preliminary Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. When you watch a train pass by you, the phenomenon that causes the sound to get louder as the train approaches and then to slowly diminish as the train moves away is called the _________________.

2. ______________ allows us to hear a conversation in a nearby room.

3. Vibrations of matter produce _____________.

4. The _________________ depends upon the medium through which sound waves travel, not the source of the sound.

5. Frequency is measured in units called ____________.

6. The pitch, or change in tone, we hear in a sound depends on the _________ of the sound wave.

7. The more _________ carried in a sound wave, the louder the sound will be.

8. A factor that affects the speed of sound is _____________.

9. ________________ is another word for the quality of sound.

10. When sounds are not pleasing to our ears, we call them ___________.

speed of sound	temperature
Doppler Effect	timbre
noise	decibels
frequency	sound
energy	hertz
sonar	diffraction

Name________________

Preliminary Test

Directions: Decide whether the answer is True (T) or False (F).

11. Sound waves travel faster than light waves. T F

12. Sound waves generally travel fastest through mediums that are gases, such as the atmosphere. T F

13. The greater the sound intensity, the less energy that is transmitted by the sound wave. T F

14. Animals that have infrasonic hearing can hear sounds above the human hearing range. T F

15. When sound waves move into a medium with a different temperature, the change in direction is called refraction. T F

16. When constructive interference occurs between sound waves, a louder sound is produced. T F

17. Three factors that affect the speed of sound are temperature, loudness, and pitch. T F

18. The lower the temperature of a medium, the slower sound waves will travel. T F

19. Sound waves are longitudinal waves. T F

20. Sound waves can travel through outer space. T F

Name__________________

Video Review

Directions: During the course of the program answer the "You Decide" questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

You Decide:

A. Can you hear music on the moon? Answer: ________________

B. Do thunder and lightning occur at the same time? Answer: ________________

C. Through which medium does sound travel faster: solid, liquid, or gas? Answer: ________________

D. What happens to the sound of a train as it passes by you? Answer: ________________

E. What allows you to hear a conversation in another room, even though you cannot see the people? Answer: ________________

Video Quiz:

1. The intensity of sound, or loudness, is measured in units called ____________.

2. Sound waves with frequencies greater than 20,000 hertz are called _____________.

3. When movement changes the frequency and pitch of a sound, you experience the __________________.

4. __________________ occurs when too many unpleasant sounds put too much stress on the human ear.

5. Destructive interference causes sound intensity to ___________.

6. The term used to describe waves that bend around objects is called _____________.

7. Sound travels ___________ on warmer days than on cooler days.

8. ___________ is a result of a vibration of matter.

9. Sound waves travel ____________ than light waves.

10. In a longitudinal wave, sound waves move ____________ to the direction of a wave.

Name________________

Post Test

Directions: Decide whether the answer is True (T) or False (F).

1. Animals that have infrasonic hearing can hear sounds above the human hearing range. T F

2. Sound waves can travel through outer space. T F

3. Three factors that affect the speed of sound are temperature, loudness and pitch. T F

4. Sound waves are longitudinal waves. T F

5. The lower the temperature of a medium, the slower sound waves will travel. T F

6. When sound waves move into a medium with a different temperature, the change in direction is called refraction. T F

7. Sound waves generally travel fastest through mediums that are gases, such as the atmosphere. T F

8. The greater the sound intensity, the less energy that is transmitted by the sound wave. T F

9. When constructive interference occurs between sound waves, a louder sound is produced. T F

10. Sound waves travel faster than light waves. T F

Name________________

Post Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

11. The ____________________ depends upon the medium through which sound waves travel, not the source of the sound.

12. Vibrations of matter produce _____________.

13. A factor that affects the speed of sound is _____________.

14. When sounds are not pleasing to our ears, we call them ___________.

15. Frequency is measured in units called ____________.

16. The more _________ carried in a sound wave, the louder the sound will be.

17. When you watch a train pass by you, the phenomenon that causes the sound to get louder as the train approaches and then to slowly diminish as the train moves away is called the _________________________.

18. _______________ is another word for the quality of sound.

19. ________________ is the process that allows us to hear a conversation in a nearby room.

20. The pitch, or change in tone, we hear in a sound depends on the ___________ of the sound wave.

sound	energy
sonar	frequency
hertz	temperature
timbre	speed of sound
noise	decibels
diffraction	Doppler Effect

Name__________________

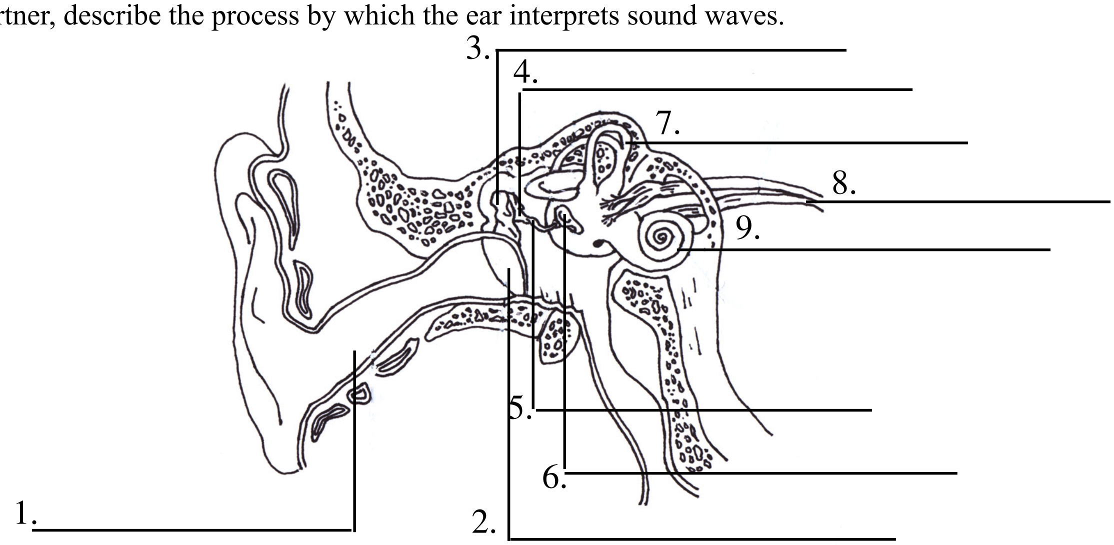
A Sound Journey

Objective: In this lab you will understand how sound waves travel in the human ear and become interpreted by the brain.

Background:
Imagine for a moment that you are a sound wave traveling through the air. Exactly what sound you are is yet to be known. Before sound waves can be identified, they must go through a process that changes sound waves into sound. In this lab, you will follow the journey of a sound wave as it travels through an ear and finally becomes decoded to produce the hidden message. Good luck on your journey through the ear!

A sound wave is first produced after a vibration of matter occurs. People's voices originate by using the muscles in their throats to vibrate the vocal cords. The vocal cords send sound waves out into the air. The sound wave is picked up by the outer ear. The outer ear is made up of the visible part on your head and a long, straight tunnel called the **ear canal**. The energy from the sound wave in the ear canal causes the **ear drum** to vibrate. Behind the ear drum is the area called the middle ear. This contains the three smallest bones in the human body: the **hammer**, **anvil**, and **stirrup.** The vibrating ear drum creates a domino effect causing the three small bones to hit one another. The vibrating stirrup presses against the **oval window,** which separates the middle ear from the inner ear. Located inside of the inner ear are the **semicircular canals** and **cochlea**. The semicircular canals are in charge of balancing the body. These three canals are at right angles to each other and are filled with fluid. The fluid tells the brain in which direction the body is moving and therefore is able to keep the body in balance. The cochlea is a small, snail shaped organ lined with tiny hair cells. It is filled with liquid that, when moved, disturbs the hair cells. The hair cells are in charge of stimulating the **auditory nerve**. This small, yet very important nerve changes sound energy into electrical signals which travel straight to the brain. Once in the brain, the signals are interpreted as sound.

Directions:
Part I:
Using the descriptions and bold words above, label the parts of the ear on the picture below. With a partner, describe the process by which the ear interprets sound waves.



Name_______________

A Sound Journey cont.

Directions:
Part II:
Fill the empty spaces using the twelve words listed below. There is a hidden message to be found by taking the boxed letter in each word and placing them in the hidden message spaces. While decoding the message, think of how the brain has to decode each sound wave in order to interpret what sound is being made.

1. ___ ___ r [ ] ___ ___ ___ ___

2. ___ n ___ ___ ___   ___ [ ] ___

3. ___ [ ] ___ i ___

4. ___ ___ d ___ ___ ___ ___ [ ]   ___ ___ ___ v ___

5. [ ] ___ ___ l   ___ ___ ___ ___ o ___

6. ___ [ ] ___ ___ ___   e ___ ___

7. [ ] a ___ ___ ___ ___

8. ___ [ ] ___ i ___ ___ ___ ___ ___ ___ ___ ___   ___ a ___ ___ ___

9. ___ ___ c ___ ___ ___ [ ]

10. ___ t ___ ___ [ ] ___ ___

11. [ ] ___ ___ d ___ ___   ___ ___ ___

12. [ ] ___ ___   ___ ___ u ___

Hidden Message: ___ ___ ___   ___ ___ ___   ___ ___ ___ ___   ___ ___ ?

oval window	**cochlea**	**hammer**
ear canal	**stirrup**	**middle ear**
semicircular canal	**outer ear**	**auditory nerve**
anvil	**ear drum**	**inner ear**

Name_______________

Homemade Music

Objective: In this lab you will produce different pitches and frequencies of sound using common, everyday objects.

Background: Music is the combination of different pitches of sound. Pitch is the highness or lowness of a sound. A sound with a high pitch has a high frequency and a sound with a low pitch has a low frequency. Pitch and frequency are determined by the amount of vibrations the sound makes per second. Humans are able to hear sounds with frequencies between 25 hertz and 20,000 hertz. Anything below or above these frequencies are sounds that the human ear is not capable of hearing.

Materials:
<u>Part A</u>:
7 glass bottles with narrow necks, preferably the same size
Water
5 small pieces of masking tape
<u>Part B</u>:
Cardboard box (shoebox)
4 rubber bands of equal length but with different widths

Procedure:
Part A:
1. Label five of the bottles one through five with the small pieces of tape.
2. Fill each of the five bottles with a different amount of water.
3. Blow across the mouth of each bottle while paying close attention to the pitch of each sound that is made.
4. Take one of the two remaining bottles and fill it with cold water. Fill the last bottle with the same amount of water, but this time use hot water. Blow across each bottle to produce a pitch.

Part B:
1. Stretch the rubber bands around the box.
2. Pluck each rubber band and listen to the different sounds that are produced.

Conclusions:
Part A:
Which bottle produces the highest sound? Which bottle produces the lowest sound? Which bottle has the highest frequency? Which has the lowest frequency? How does the amount of water affect the sound? How does the water temperature affect the sound?
Part B:
Which rubber band produces the most vibrations? Which produces the highest pitch? The lowest pitch? If the rubber band made no sound at all, how would you explain this?

Name_________________

Seeing Sound

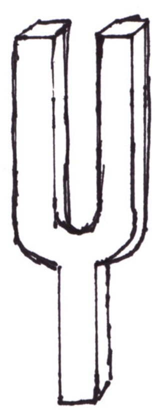
Objective: In this, lab students will use a tuning fork to observe that sound is produced by vibrations.

Background: Sound is produced when the vibration of matter travels in a wave. The waves created by the vibrations cannot be seen but at times their effects are visible. Have you ever been close to a speaker that is playing loud music and noticed that your hair and clothes are vibrating? Or have you ever placed a glass of water near a speaker and seen ripples being produced? This is due to the vibrations of sound. Waves strike the objects, causing them to vibrate as well.

Material:
Tuning fork
Glass cup
Water

Procedure:
1. Strike the tuning fork lightly against the side of a table.
2. Observe the tuning fork and take note of any movement.
3. Strike the tuning fork against the table to continue its vibration.
4. Hold the tuning fork close to your ear. Observe what happens.
5. Strike the tuning fork against the side of the table again.
6. Place the tuning fork in the glass of water. Observe what occurs.

Conclusion: Describe the sound coming from the tuning fork. During which step is the vibration most visible? Brainstorm why this is so.



Name_________________

Whales and Sound

Directions: Read the following passage about the effects of noise pollution on the largest mammal, the whale. Answer the questions that follow.

Ocean Noise

Imagine yourself as a whale. You do not live in a visual environment, but in an environment where you must use your ears to navigate through the dark depths of the ocean. You rely on your sense of sound in order to communicate, find food, and protect your family from predators. How would loud noises in your environment affect your ability to survive?

Detecting and emitting sounds is critical for a whale to survive. Whales have ear structures highly specialized for hearing underwater, such as extremely hard and dense ear bones. There are two major groups of whales and each uses a different way of hearing. Toothed whales send out high-pitched ultrasonic sounds and then listen for echoes that bounce off other objects in the ocean. This process is called echolocation. Baleen whales also use echolocation, but emit low-frequency infrasonic sounds to communicate over very long distances. Whales have such a magnificent sense of sound that they are believed to be able to communicate with each other across thousands of miles.

Since whales rely so heavily on their sense of sound, loud noises in the ocean may disrupt their regular activities. Three significant types of noise that may disrupt ocean life are noises from military submarine sonar, oil exploration, and supertankers. Scientists have conducted research on noise pollution and found certain areas of the ocean to be extremely noisy. The busiest parts of the North Atlantic Ocean have registered more than 100 decibels. This measurement is equivalent to the loudness of rush hour in a metropolitan area. This is a very noisy ocean, considering that the pain threshold for human ears is 120 decibels and that of whales is estimated to be 170 decibels. Some ocean noises are natural, such as the noises from the movement and communication of ocean animals. However, most ocean noises are a result of human activity.

The effect of noise pollution on whales is a controversial issue. In the early 1990's, scientists for the US Navy began conducting research and tests on a new technology called low-frequency active sonar. This type of sonar will give the Navy the ability to detect submarines that are too quiet to be detected with the type of sonar the Navy currently uses. Low-frequency active sonar emits sounds that are low in frequency and pitch, but have a high intensity level, capable of producing sounds as loud as 235 decibels to 280 decibels.

Research has found that sounds over 140 decibels have caused whales to abandon their breeding grounds. Still, there is uncertainty about the damage caused to whales by low-frequency active sonar. Environmentalists and other organizations claim that low-frequency active sonar does harm whales. In order to comply with environmental laws, the Navy performed tests on low-frequency active sonar to determine if using the technology will harm whales. The interpretations of the test results vary. Environmental organizations and others are trying to stop the Navy from using low-frequency active sonar, while the Navy is trying to proceed with their plans to use the new technology.

Name________________

Whales and Sound cont.

Directions: Part I: Circle the correct multiple choice answer. Part II: Decide whether the statement is True (T) or False (F).

Part I

1. The human ear's threshold for pain is:

A. 100 decibels B. 235 decibels
C. 170 decibels D. 120 decibels

2. Three significant types of noise that cause noise pollution in the ocean are:

A. military submarine sonar, marine animals communicating, and nuclear and diesel submarines
B. military submarine sonar, supertankers, and technologies used for oil exploration.
C. technologies used to find gas and oil deposits, LFAS technology and the movement of marine animals
D. scientific research, LFAS technology and nuclear and diesel submarines.

3. An adaptation of whales that contributes to their extraordinary sense of sound is:

A. very large ears B. hard and dense ear bones
C. echolocation D. both B and C

4. According to research, 140 decibels has been known to cause whales to:

A. Lose their ability to use echolocation.
B. Lose their ability to communicate over long distances.
C. Leave their breeding grounds.
D. Emit high-frequency sounds.

Part II

1. Low-frequency Active Sonar emits very loud high-pitched sounds. T F
2. The US Navy wants to use low-frequency active sonar (LFAS) technology to detect quiet submarines that cannot be detected with passive sonar. T F
3. Some whales navigate through the ocean by detecting sounds that bounce off ocean objects in a process called echolocation. T F
4. The results of the tests performed by the Navy showed that LFAS technology does not harm whales. T F
5. The noises in the ocean that may disrupt or harm marine animals are mostly natural noises. T F

Part III

Research where the issue of LFAS stands today. Write a short essay that explains your own opinion of sonar technology and its affect on marine life. Should the Navy use LFAS to find quieter submarines?

Name________________

Vocabulary of *Sound*

Directions: Unscramble the following vocabulary words and match each word with its correct definition.

___ 1. ercfeqnuy

___ 2. citph

___ 3. zhter

___ 4. cinosarfni

___ 5. hte plodrep fetcef

___ 6. cfrentoiar

___ 7. suivctderet eteifrncener

___ 8. tvcuosnercit cifetenernre

___ 9. cfatrindfio

___ 10. sineo ltnilopuo

___ 11. nisutlacro

a. Sound below the range of human hearing.

b. The change in frequency and pitch of a sound due to a movement in the source of the sound or the listener.

c. When the compression of one sound wave meets a compression of another sound wave, the result is an increase in sound intensity.

d. When a compression in one sound wave meets a rarefaction in another sound wave, the result is a decrease in sound intensity.

e. A term used to describe waves that bend around objects.

f. Sound above the range of human hearing.

g. Property of a sound that depends upon the frequency of a wave.

h. When too many unpleasant sounds cause stress to humans.

i. Units that measure the frequency of sound.

j. The number of sound waves that pass a point in a given time.

k. The change in direction of a wave as it moves into a medium with a different temperature or density.