DK-23079

SOUND

by David Alan Herzog

Graphics by David Alan Herzog
and Karen Smolinski Foster

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information about this program.

ABOUT THE AUTHOR

David Alan Herzog has taught in the New York City Public Schools and on the university level. He has written and contributed to many textbooks and audiovisual packages in the fields of science, mathematics, social studies, and language arts.

Among the software programs that he has written are DRAGON GAMES, ALLIGATOR GAMES, SOUTH DAKOTA, SANTA FE TRAIL, and THE MICRO GARDENER.

He received his B.A. degree from C.C.N.Y. in 1963, and did graduate work at C.C.N.Y., N.Y.U., and Syracuse University. He has served as consultant, project associate, and instructor at Columbia University, Syracuse University, William Paterson College, and Fairleigh Dickinson University.

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SPECIAL FEATURES

OVERVIEW

Sound begins by examining wave anatomy, exploring the features of transverse waves, and considering the effects of frequency and amplitude upon sound. Students learn about the generation and structure of longitudinal waves. The unit of frequency is stated, and the generation of waves of varying frequencies is simulated.

The disk goes on to explore the speed of sound, comparing it to that of light and demonstrating the influences of temperature and medium upon it. Two separate simulations permit the student to experiment with the speed of sound in various media and to determine the distance of a lightning strike by the delay in hearing the associated thunder. The Doppler effect is explored through two additional simulations. This leads to a brief discussion of hearing. The human ear is examined on screen as students first follow a sound wave through the ear, and then identify the various parts of the ear.

Each of the four programs contains internal reviews, and concludes with a five-question formal review, each of which is drawn from a bank of questions dealing with the subject matter covered in that particular lesson.

LEVELS

Grades 5 through 8

PREREQUISITES

Students should be reading at or above a fifth grade level. They should also be acquainted with the concept of energy — especially heat and light.

COURSE SUITABILITY

Sound is a highly interactive introduction to the nature, origin, and characteristics of sound. Simulations are used to demonstrate the creation and transmission of sound waves, the Doppler effect, the speed of sound in different media, stereophonic hearing, and more. This disk may be used in conjunction with any appropriate text materials, and can serve as reinforcement or introduction to text lessons, as well as for remediation or enrichment (depending upon grade level).

TYPE OF PROGRAM

The four programs on this disk are highly interactive graphic/text tutorials, with liberal use of simulation and animation, and contain internal reviews and reinforcements.

APPROXIMATE TIMINGS

Each of the four programs on this disk will run between 10 and 15 minutes. Of course, the amount of time needed to complete each program will vary with the speed at which each student works.

PERFORMANCE OBJECTIVES

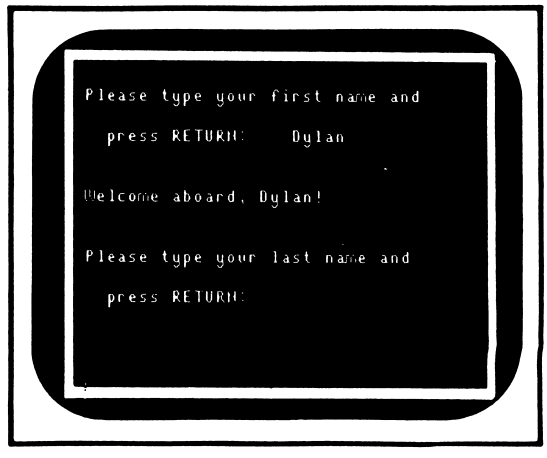
After having successfully completed all portions of Sound, the student will be able to:

- distinguish between transverse and longitudinal waves, and state which types of energy travel as each;
- distinguish frequency, amplitude, and wavelength of transverse waves, and state that the Hertz is the unit of frequency;
- state that human hearing falls within the range of 45 to 16,000 Hz;
- identify the speed of sound at 0 degrees Celsius as about 1090 feet per second, or 331 m/sec; state that sound travels at different speeds through different media, and increases at the rate of about .6 m/sec for each degree rise in temperature in air;
- state that sound travels fastest through solids and slowest through gases;
- determine the distance away a lightning strike is by the delay in hearing the thunder;
- describe in detail the cause and effect of the Doppler phenomenon, and identify all parts of the human ear.

(All sample screens shown in this guide are from various versions of SOUND. Each version will vary.)

HOW THE PROGRAM WORKS

When the program begins, the EA logo/title frame appears first. This is followed by a screen which asks the student to type in first and last names.



After a few seconds during which the computer checks and updates the management files, the computer will automatically begin the first program that the student has not yet successfully completed. (See Management System, page 4, for additional information on this feature.)

If the student has already successfully completed all four programs on the disk, the computer will acknowledge that fact and display a menu allowing the student to choose any program that s/he wishes to do. The choices will be:

1 - Making Waves
2 - The Speed of Sound
3 - The Doppler Effect
4 - Sound and Human Hearing

While running the programs, a flashing cursor in the lower right corner of the screen is a signal to the student to press the space bar to continue.

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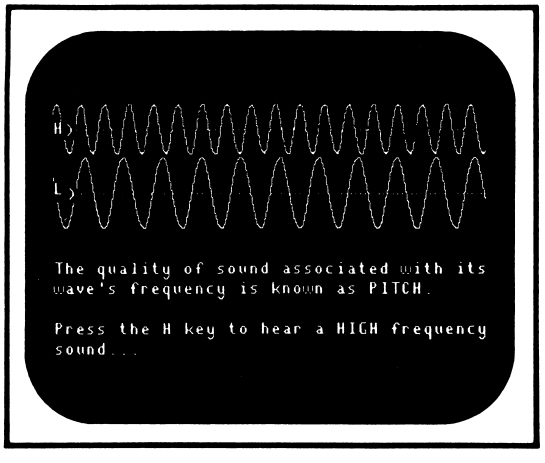
1 - Making Waves

This program opens with a demonstration of the generation of transverse waves by dropping a stone into water. It goes on to study the anatomy and properties of transverse waves, including frequency, amplitude, and wavelength, the first two of which are associated with discernible properties of sound. A simulation permits students to generate transverse waves of various frequencies.

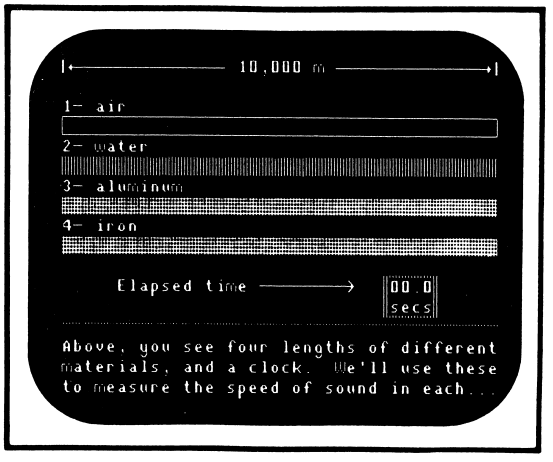
Next, longitudinal waves are studied, and students simulate the generation of compressions and rarefactions that comprise a longitudinal wave. The association of frequency with pitch and amplitude with loudness is reinforced. The lesson concludes with a final review of five randomly selected questions.

A sample screen from this lesson is shown below:



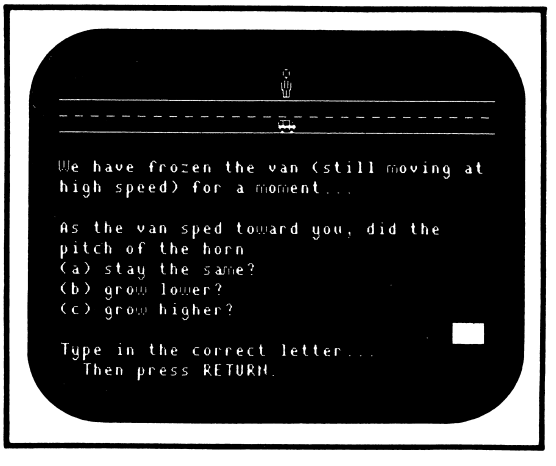
2 - The Speed of Sound

This program compares the speed of sound with that of light. Students then use a simulation to determine the speed of sound in various media. Another simulation gives students the opportunity to determine the distance of a lightning flash based upon the time after the flash before thunder is heard. A review of five randomly selected questions concludes the lesson.



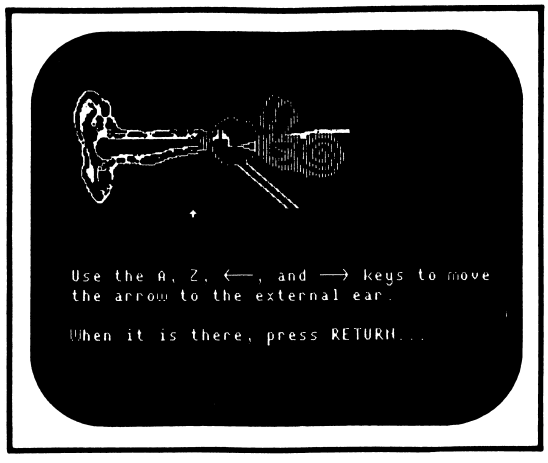
3 - The Doppler Effect

This program opens with a demonstration of the effect in animated form. The effect is then analyzed step by step through an animated simulation in which students control the motion of a vehicle past a listener. Finally, an animated sequence puts all the pieces together to demonstrate both the effect while approaching and while moving away from a listener. The usual review of five random questions concludes the lesson.



4 - Sound and Human Hearing

This program studies a person as a sound receiver and reactor. Students follow a sound wave through the outer, middle, and inner ear, and finally out the auditory nerve to the brain. Next, students identify the various parts of the ear (including the semicircular canals and the Eustachian tubes). Finally, there is a graphic simulation of stereophonic hearing, demonstrating how it works to provide information on where a sound comes from. A review of five random questions concludes the lesson.



MANAGEMENT SYSTEM

How It Works

The lessons on this disk are meant to be used sequentially by the students. For that purpose, as well as the purpose of teacher record-keeping, a management system governs access to the programs on the disk.

Each time the disk is booted, the student will be asked to type his/her first and last names.

If the computer, having checked the records kept on the disk, determines that the student has not done the first program, or has achieved a score of less than the current mastery level on the first program, then s/he will be sent automatically to the first program on the disk.

Until such time as a student signing on has successfully completed every program on the disk, the computer will continue to prescribe the programs to be done, in sequence.

Each time a student has unsuccessfully (scoring less than the current mastery level on the final review) completed a program, s/he will be offered the choice of repeating the program immediately. If the student chooses not to repeat the program at this time, when s/he returns to the program and enters first and last names, that same program will automatically display.

If a student has successfully completed a program, s/he will be given the option of going on to the next program immediately. Again, this next program will automatically display the next time the student signs on.

When a student has successfully completed all programs on the disk, s/he may wish to go back and review a particular program, or you may wish to have him/her do that. When that student signs on, the computer, after checking the files, will send him/her to a menu to select that program which s/he wishes to repeat.

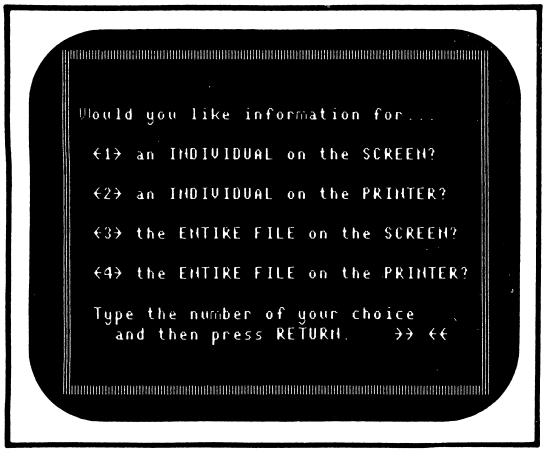
If a student who has completed all programs successfully, chooses to repeat a particular program, and does so unsuccessfully, the next time that student signs on, s/he will be immediately directed to the same program, until such time as it is completed successfully.

Checking the Scores

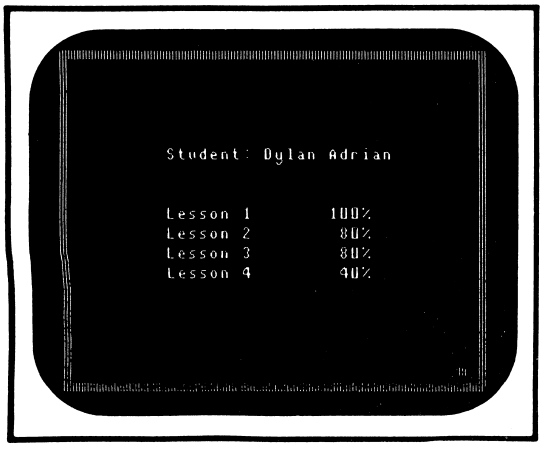
This disk contains a record of the students who have completed each program on the disk.

You may view these records by typing the command, **Scores,** when the computer displays, "Please type your first name and press <RETURN/ENTER>."

The computer will then ask if you want a single student's file or the files on all students, and will also give the option of viewing these results on the screen or having them printed out if a printer is available.



Once these options have been decided upon, the following information will display: (1) the name of the student; (2) the programs on that disk; and (3) the most recent percentage score attained for each program.



As many as 75 students may be maintained on this disk.

Purging the File

The command, **Purge,** typed in when the computer asks, "Please type your first name and press <RETURN/ENTER>," will give you the option to delete an individual student file or all student files on this disk.

The purge option can be used for a variety of situations.

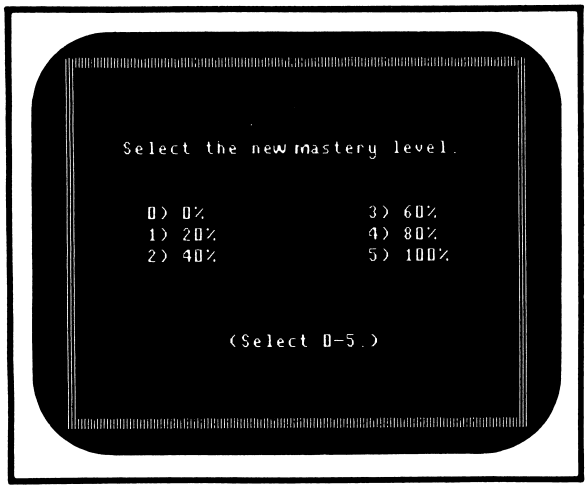
If a disk becomes full, a message will appear so you can utilize the purge option.

Scale Option

This program has been shipped with a *preset* passing grade of 60% for all programs contained on the disk.

If you wish to change this passing grade, type **Scale** when the computer asks, "Please type your first name and press <RETURN/ENTER>."

You will then be told the current mastery level and asked if you wish to change it. If so, you'll be offered a disk-specific choice of grades.



Once you've made your selection, you will be shown the *new* passing grade and asked if it is correct. If you've changed your mind, answer "N" (for no) and you'll be returned to the previous frame, where you may select a new grade.

Once the passing grade has been changed, it will remain on the disk *even after the computer has been turned off.* You may change it again at any time by repeating the procedure outlined above.

Note: If you set the mastery level at 0%, the program will no longer demand that the students do the lessons in a sequence, but rather will display the menu from which they may choose the programs they wish to do.

It is suggested that, if you are using this disk for the first time, you check it first to see what the mastery level is on the disk before assigning it to your students.

Teacher Option

This disk contains a special option that will allow the teacher direct access to the program menu and, consequently, all lessons on the disk.

If you type **Teacher** when the computer asks, "Please type your first name and press <RETURN/ENTER>," you will be sent to the menu where you can select whichever program(s) you wish to see.

Using this option bypasses the regular record-keeping function of the management system, so any scores obtained on these lessons will NOT be stored on the disk.

If you wish to quit a lesson at any time, holding down the CONTROL key and pressing the C key at the same time will return you to the name input frame at the beginning of the program.

SUPPLEMENTAL ACTIVITY WORKSHEETS

The reproducible activity worksheets included with the disk are designed to be used by students after completion of a program on the computer. There are between one and three activity sheets for each program, as well as a single sheet which recapitulates subject matter from the entire disk. These serve to further reinforce, and in some cases to extend, the student's understanding of the subject matter covered.

You may choose to assign these sheets for individualized seat-work (after a student's computer time is over), or as homework. It is suggested that the sheets be assigned while the student's computer experience is still fresh in his/her mind in order to gain maximum effectiveness from them.

SUPPORT SERVICES

If you need immediate help with any EA microcomputer program, dial our toll free number, 800-645-3739 (New York State, Alaska, and Hawaii dial 516-223-4666). Ask for our CUSTOMER SERVICE DEPARTMENT.

ANSWER KEY

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SOUND

1. Making Waves

I. 1. The distance between the crests of two adjacent waves is known as the wavelength.

2. The height of a wave is called its amplitude.

3. The number of waves per unit of time is known as frequency.

4. The unit of frequency is the Hertz.

5. Three types of transverse wave are light, heat, and x-ray.

6. Sound waves are not transverse; they are longitudinal.

7. The higher the pitch of a sound, the greater the sound wave's frequency.

8. The louder a sound, the greater the sound wave's amplitude.

9. Sound is the result of vibrations.

10. Sound waves consist of two areas of pressure. These are called compressions and rarefactions.

II. Try this experiment.

1. Stretch a rubber band between two nails or other posts. (The part of the rubber band between the posts must not be touching any surface.)
2. Pull the center of the rubber band toward you, and then let go.
3. You should hear a sound as the rubber band vibrates. (If you do not, wind the band around the posts a few times or use a smaller rubber band.)
4. Note the pitch of the sound.
5. Pinch the rubber band about an inch from either end and repeat step #2.

6. How was the sound's pitch changed? It's higher

7. What can you say about the speed at which the rubber band is vibrating? It's faster than before.

8. Wrap the rubber band a few turns around either post and repeat steps #2, 4, 6, and 7.

9. What conclusions can you draw? Shorter and tighter rubber bands vibrate more quickly and make higher pitched sounds than longer and looser ones.

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SOUND

2. The Speed of Sound

I. 1. Explain what you know about the ability of sound to travel in a vacuum. Sound cannot travel through a vacuum; our not being able to hear the sun is evidence of this.

2. You see a person fire a gun. Three seconds later you hear the sound of the gunshot.

What does that tell you? Explain: The shooter was about a Kilometer away. Sound travels about a Kilometer in 3 seconds, while light travels almost instantaneously.

II. Build a telephone.

1. You will need two empty cans (soup size), two 1- or 1-1/2 inch finishing nails, four to five meters (12-16 feet) of string or thin, non-insulated wire, a hammer, and a friend.
2. After the cans have been washed and dried, punch a hole through the center of the bottom of each one using the hammer and a nail.
3. Push one end of the wire through the bottom of one can from the outside so that the end winds up inside the can.
4. Pull the end of the string or wire out through the top of the can far enough to tie it securely around the middle of one of the nails.
5. Pull the wire from outside the bottom of the can so that the nail is pulled back into the can and stops at the bottom.
6. Repeat steps #3 through 5 with the second can and the other end of the wire.
7. Have your friend walk away from you until the string is stretched taut between the two cans. Make sure that nothing touches the string (you may need to go outdoors to do this).
8. Take turns talking into the can and listening with the can to your ear, making sure that the string stays taut. You've just reinvented the telephone!

What does this telephone prove? Sound travels through solids.

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SOUND

3. The Doppler Effect

1. Why does sound appear to be growing higher in pitch as its source approaches you at high speed? While the sound being emitted is that of a single pitch, the sound source moving toward you causes the waves to come faster than they normally would, one upon another. This means that waves are reaching you with increasing frequency, and frequency is what determines the sound's pitch.

2. Why does sound appear to be growing lower in pitch as its source moves away from you at high speed? As the source moves away, the distance increases continuously between you and it. That causes the distance between succeeding waves to increase. That increase in distance between waves corresponds to a decrease in frequency – a lowering of pitch.

3. Why does the Doppler effect occur ONLY when the distance between the listener and the source of sound are changing at HIGH SPEED? If the distance between the listener and the source were changing slowly, the relative change in the rate at which the waves generated by succeeding vibrations at the source brought about by the motion would be so small as to be undetectable to your ear. You would therefore notice no change in pitch.

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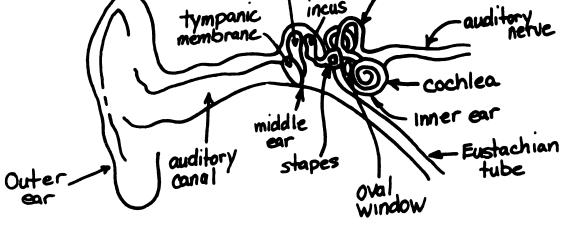
SOUND

4. Sound and Human Hearing

I. Below is a cross-section drawing of the human ear. Label the following parts: outer ear, cochlea, stapes (stirrup), malleus (hammer), Eustachian tube, auditory canal, semicircular canals, tympanic membrane, middle ear, inner ear, incus (anvil), auditory nerve, oval window.



II. 1. Where does hearing actually take place? the auditory center of the brain

2. The auditory canal connects the external ear and the eardrum.

3. The tympanic membrane is more popularly known as the eardrum.

4. The ossicles are the three smallest bones in the human body. Their names are stapes(stirrup), malleus(hammer), and incus(anvil).

5. The semicircular canals give your body its sense of balance.

III. What would you miss most if you lost your hearing? answers will vary

SOUND

1. Making Waves

I. 1. The distance between the crests of two adjacent waves is known as the _____.

2. The height of a wave is called its _____.

3. The number of waves per unit of time is known as _____.

4. The unit of frequency is the _____.

5. Three types of transverse wave are _____, _____, and _____.

6. Sound waves are not transverse; they are _____.

7. The higher the pitch of a sound, the greater the sound wave's _____.

8. The louder a sound, the greater the sound wave's _____.

9. Sound is the result of _____.

10. Sound waves consist of two areas of pressure. These are called _____ and _____.

II. Try this experiment.

1. Stretch a rubber band between two nails or other posts. (The part of the rubber band between the posts must not be touching any surface.)
2. Pull the center of the rubber band toward you, and then let go.
3. You should hear a sound as the rubber band vibrates. (If you do not, wind the band around the posts a few times or use a smaller rubber band.)
4. Note the pitch of the sound.
5. Pinch the rubber band about an inch from either end and repeat step #2.

6. How was the sound's pitch changed? _____

7. What can you say about the speed at which the rubber band is vibrating? _____

_____

8. Wrap the rubber band a few turns around either post and repeat steps #2, 4, 6, and 7.

9. What conclusions can you draw? _____

_____

_____

Name _____ Class _____ Date _____

SOUND

2. The Speed of Sound

I. 1. Explain what you know about the ability of sound to travel in a vacuum. _____

_____

_____

_____

_____

2. You see a person fire a gun. Three seconds later you hear the sound of the gunshot.

What does that tell you? Explain: _____

_____

_____

_____

_____

II. Build a telephone.

1. You will need two empty cans (soup size), two 1- or 1-1/2 inch finishing nails, four to five meters (12-16 feet) of string or thin, non-insulated wire, a hammer, and a friend.
2. After the cans have been washed and dried, punch a hole through the center of the bottom of each one using the hammer and a nail.
3. Push one end of the wire through the bottom of one can from the outside so that the end winds up inside the can.
4. Pull the end of the string or wire out through the top of the can far enough to tie it securely around the middle of one of the nails.
5. Pull the wire from outside the bottom of the can so that the nail is pulled back into the can and stops at the bottom.
6. Repeat steps #3 through 5 with the second can and the other end of the wire.
7. Have your friend walk away from you until the string is stretched taut between the two cans. Make sure that nothing touches the string (you may need to go outdoors to do this).
8. Take turns talking into the can and listening with the can to your ear, making sure that the string stays taut. You've just reinvented the telephone!

What does this telephone prove? _____

_____

Name _____ Class _____ Date _____

SOUND

3. The Doppler Effect

1. Why does sound appear to be growing higher in pitch as its source approaches you at high speed? _____

2. Why does sound appear to be growing lower in pitch as its source moves away from you at high speed? _____

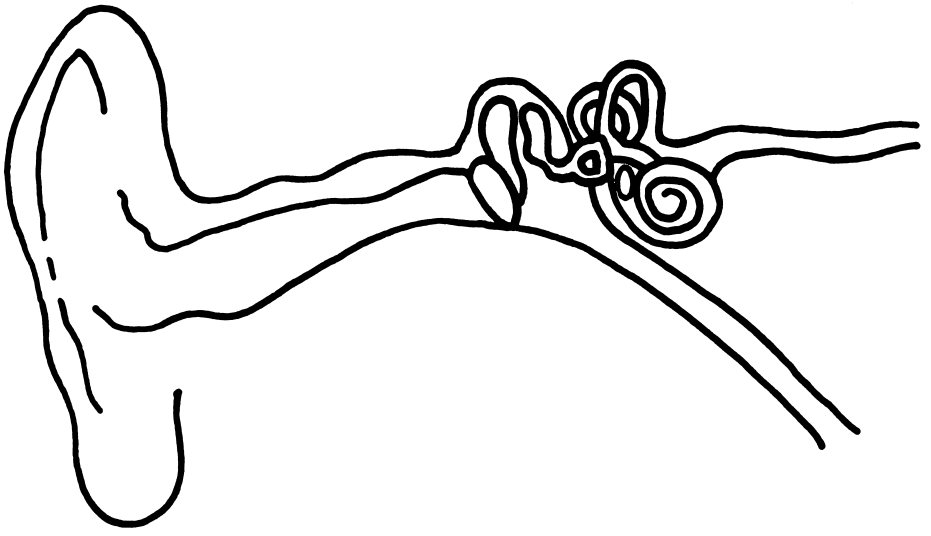
3. Why does the Doppler effect occur ONLY when the distance between the listener and the source of sound are changing at HIGH SPEED? _____

Name _____ Class _____ Date _____

SOUND

4. Sound and Human Hearing

I. Below is a cross-section drawing of the human ear. Label the following parts: outer ear, cochlea, stapes (stirrup), malleus (hammer), Eustachian tube, auditory canal, semicircular canals, tympanic membrane, middle ear, inner ear, incus (anvil), auditory nerve, oval window.



II. 1. Where does hearing actually take place? _____

_____

2. The auditory canal connects the _____ and the _____.

3. The tympanic membrane is more popularly known as the _____.

4. The ossicles are the three smallest bones in the human body. Their names are

_____, _____, and _____.

5. The semicircular canals give your body its sense of _____.

III. What would you miss most if you lost your hearing? _____

_____

_____

_____

Name _____ Class _____ Date _____

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Instructions for Operating Your APPLE II® Disk Program

1. Insert the disk into the Drive. Use Drive I when two drives are present.

2. Turn on the computer and the monitor and wait until the IN USE light on the Drive goes off.

3. The program will execute and A will be displayed. If this doesn't appear, restart the procedure.

4. After the introductory remarks have been displayed, the PROGRAM MENU will appear on the screen. Select the program you wish by following the instructions on the screen. (Single program diskettes do not contain a MENU.)

5. If you would like to stop in the middle of a program, press the CTRL key and the "C" key simultaneously, then press RETURN. This will bring you back to the PROGRAM MENU.

6. To return to the introductory remarks, press the CTRL key and the RESET key simultaneously.

7. If you wish to use a different disk, place it in the Drive and press the CTRL key and the RESET key simultaneously.