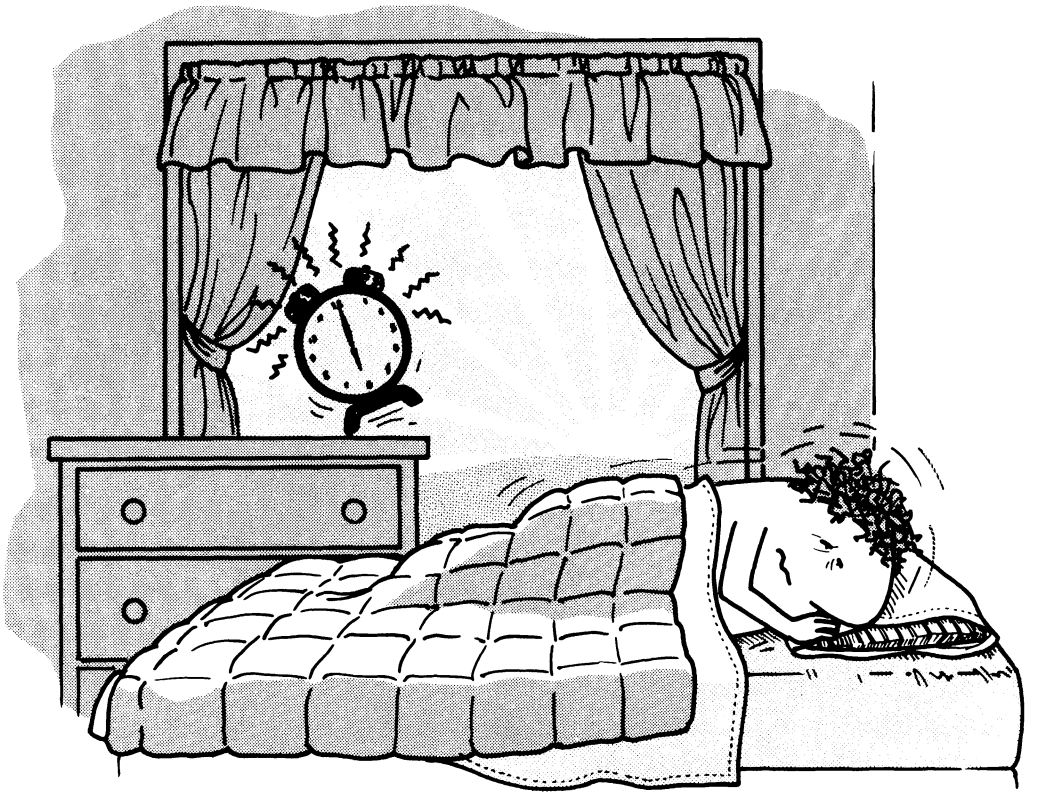
SOUND



TASK CARD SERIES

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INTRODUCTION

TEACHING NOTES

REPRODUCIBLE STUDENT TASK CARDS

Gathering Materials

Listed below is everything you'll need to teach this module. You already have many of these items. The rest are available from your supermarket, drugstore and hardware store. Laboratory supplies may be ordered through a science supply catalog. Hobby stores also carry basic science equipment.

Keep this classification key in mind as you review what's needed:

special in-a-box materials: Italic type suggests that these materials are unusual. Keep these specialty items in a separate box. After you finish teaching this module, label the box for storage and put it away, ready to use again the next time you teach this module.	general on-the-shelf materials: Normal type suggests that these materials are common. Keep these basics on shelves or in drawers that are readily accessible to your students. The next TOPS module you teach will likely utilize many of these same materials.
(substituted materials): A parentheses following any item suggests a ready substitute. These alternatives may work just as well as the original, perhaps better. Don't be afraid to improvise, to make do with what you have.	*optional materials: An asterisk sets these items apart. They are nice to have, but you can easily live without them. They are probably not worth an extra trip, unless you are gathering other materials as well.

Everything is listed in order of first use. Start gathering at the top of this list and work down. Ask students to bring recycled items from home. The teaching notes may occasionally suggest additional student activity under the heading "Extensions." Materials for these optional experiments are listed neither here nor in the teaching notes. Read the extension itself to find out what new materials, if any, are required.

Needed quantities depend on how many students you have, how you organize them into activity groups, and how you teach. Decide which of these 3 estimates best applies to you, then adjust quantities up or down as necessary:

$Q_1 / Q_2 / Q_3$

- **Single Student:** Enough for 1 student to do all the experiments.
- **Individualized Approach:** Enough for 30 students informally working in 10 lab groups, all self-paced.
- **Traditional Approach:** Enough for 30 students, organized into 10 lab groups, all doing the same lesson.

KEY: *special in-a-box materials* (substituted materials) general on-the-shelf materials *optional materials

$Q_1 / Q_2 / Q_3$		$Q_1 / Q_2 / Q_3$	
1 / 15 / 30	*tuning forks — long (low) ones have the widest application in this module; at least some should be stamped to identify their vibrating frequency*	1 / 10 / 10	meter sticks or other metric rulers
		1 / 1 / 1	a wall clock with second-hand sweep (student wrist watches)
1 / 10 / 10	drinking glasses or beakers	1 / 10 / 10	*hand calculators
4 / 20 / 40	*bobby pins*	1 / 3 /10	Ping-Pong balls (marbles)
4 / 40 / 40	medium sized cans	1 / 6 / 10	dinner forks (spoons)
2 / 10 / 20	soda bottles or equivalent	1 / 1 / 1	roll of string
1 / 10 / 10	scissors	1 / 5 / 10	*hammer and nails — needed for punching holes in cans; these can be omitted if this operation is completed in advance
4 / 40 / 40	4x6 index cards		
1 / 2 / 2	rolls adding-machine tape	7 / 70 / 70	straight plastic straws
2 / 20 / 20	straight pins	.2 / 1 / 2	cups of clay
1 / 2 / 2	rolls masking tape	2 / 15 / 20	paper clips
3 / 15 / 30	clothespins	1 / 1 / 1	bottles cooking oil (baby oil)
3 / 30 / 30	rubber bands	1 / 1 / 1	roll of thin bare wire — iron, copper or aluminum; 22 gauge is appropriate
1 / 1 / 1	*jar petroleum jelly*		
1 / 10 / 10	panes of glass approximately 10x10 cm; microscope slides will serve in a pinch; hand mirrors work nearly as well	1 / 1 / 1	*wire cutters
		1 / 4 / 10	tuna fish cans or equivalent
		1 / 4 / 10	*old records*
1 / 20 / 50	pennies	1 / 1 / 1	paper punch
1 / 1 / 1	spool of thread	1 / 1 / 1	*pairs of wood blocks (a spoon and pan)*

Sequencing Task Cards

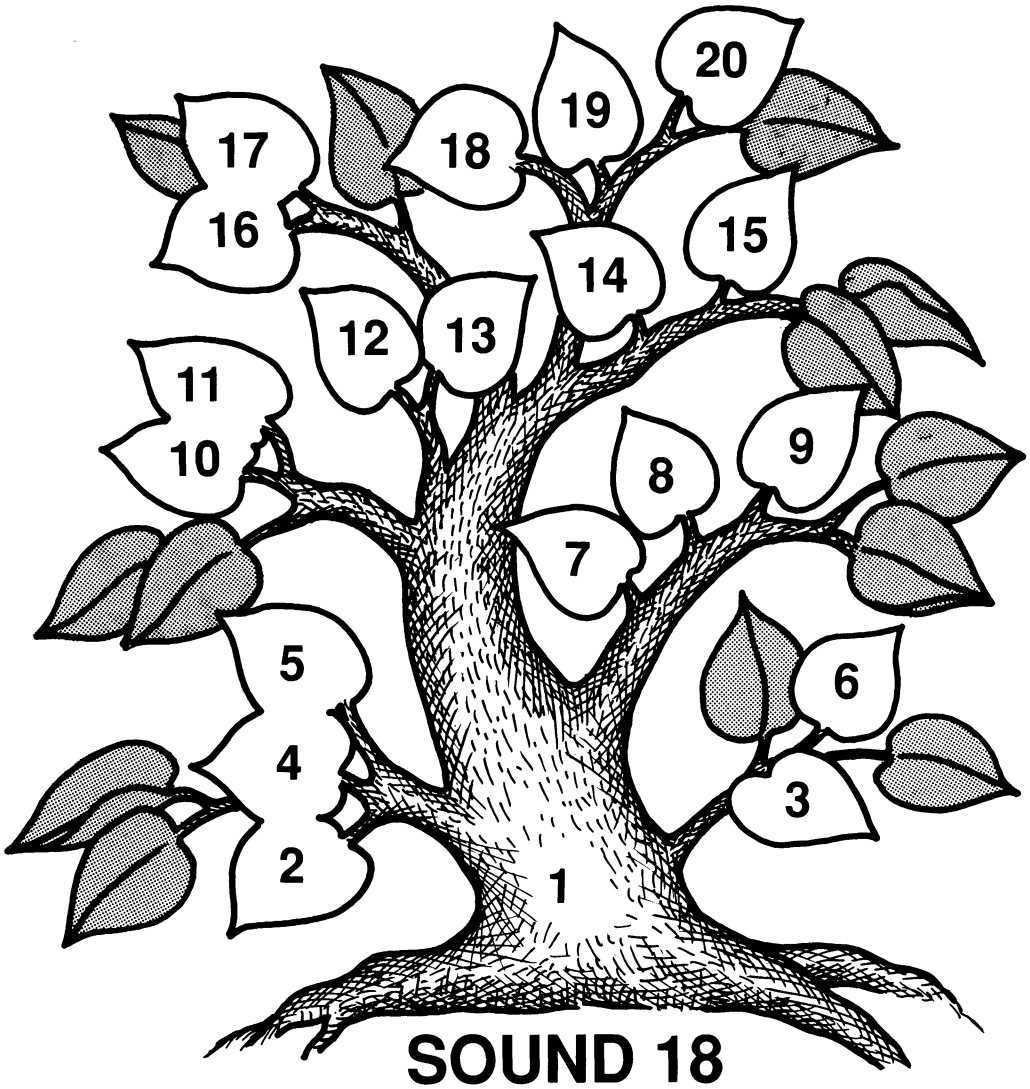
This logic tree shows how all the task cards in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. As the diagram suggests, the way to upper level activities leads up from lower level activities.

At the teacher's discretion, certain activities can be omitted or sequences changed to meet specific class needs. The only activities that must be completed in sequence are indicated by leaves that open *vertically* into the ones above them. In these cases the lower activity is a prerequisite to the upper.

When possible, students should complete the task cards in the same sequence as numbered. If time is short, however, or certain students need to catch up, you can use the logic tree to identify concept-related *horizontal* activities. Some of these might be omitted since they serve only to reinforce learned concepts rather than introduce new ones.

On the other hand, if students complete all the activities at a certain horizontal concept level, then experience difficulty at the next higher level, you might go back down the logic tree to have students repeat specific key activities for greater reinforcement.

For whatever reason, when you wish to make sequence changes, you'll find this logic tree a valuable reference. Parentheses in the upper right corner of each task card allow you total flexibility. They are left blank so you can pencil in sequence numbers of your own choosing.



Review / Test Questions

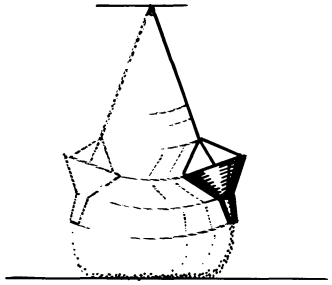
Photocopy the questions below. On a separate sheet of blank paper, cut and paste those boxes you want to use as test questions. Include questions of your own design, as well. Crowd all these questions onto a single page for students to answer on another paper, or leave space for student responses after each question, as you wish. Duplicate a class set and your custom-made test is ready to use. Use leftover questions as a review in preparation for the final exam.

task 1

Flying insects buzz and hum. How do they produce these sounds?

task 2

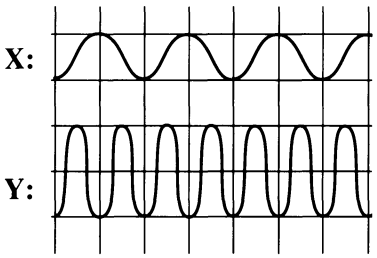
A funnel of sand swings back and forth while sand pours out in a small steady stream from the bottom.



a. Explain how you would use this special pendulum to make sand waves on paper.
b. How would you alter the wave-length of your sand waves?

task 3

Each square on the grid measures 1 cm by 1 cm. What is the wave-length and amplitude of wave x? wave y?

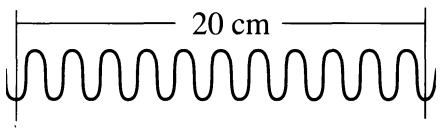


task 4

A tiny 1 cm pendulum vibrates about 300 cycles per minute. Find its frequency in Hertz units.

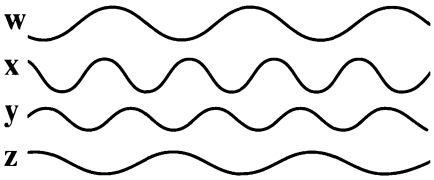
task 5-6

This 440 Hz vibration is recorded over a distance of 20 cm. How fast did the wave travel in cm/sec? in meters/sec?



task 7-8

Which greased glass tracing was made with...
a. a low pitched tuning fork sounding at low intensity?
b. a high pitched tuning fork sounding at high intensity?
c. a high pitched tuning fork sounding at low intensity?

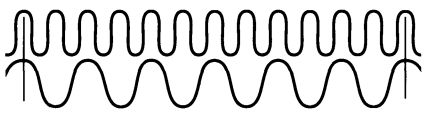


task 7-8

Why is the buzz of a bumble bee lower than the hum of a mosquito? Why is it louder?

task 8

Two tuning forks were moved together across greased glass, leaving these wave trains. If the higher fork vibrates at 256 Hz, what is the frequency of the lower fork?



task 9

A meteor hits a space station orbiting high above Earth.
a. Do astronauts inside hear the sound of its impact? Explain.
b. Does an astronaut working nearby on the outside of the space station hear its impact?

task 10-11

How are ocean waves different from sound waves? Draw a representation of each.

task 12

Name 3 different ways to lower the pitch on a stringed instrument.

task 13

You are given some empty soda bottles. Describe how you can use these bottles to create ascending and descending notes.

task 14

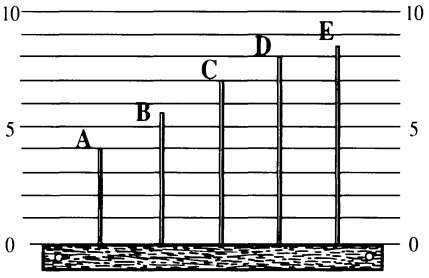
Explain these observations using the idea of sympathetic pushes and resonance.
a. To push a car out of a ditch you should begin by rocking it to and fro.
b. When you sing in the shower, some notes sound louder than others.

task 15

A piano tuner hears 3 beats per second when comparing an A on the piano with standard A (in the same octave), on his tuning fork. If the tuning fork vibrates at 440 Hz, what is the frequency of the piano note? How should the tuner adjust the string to sound at the correct pitch?

task 16-17

Each wire is wedged tightly between 2 pieces of wood as shown. Background lines reveal their respective lengths. Which wires sound at the same note in different octaves? Explain how you know.



task 18

Spinning a record too fast raises the pitch of the music. Explain why.

task 19

Explain how a saxophone...
a. produces sound.
b. changes pitch.

task 20

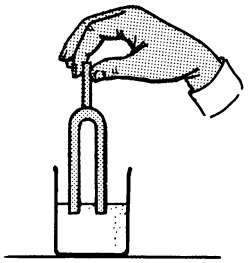
A friend claps two boards together, with broad sweeping gestures, at a constant frequency of 2 Hz. Meanwhile you back away. After 80 meters, what you hear seems out of phase with what you see. After 160 meters, what you see and hear again seem to coincide.
a. Explain what is happening.
b. Calculate the speed of sound in this experiment.

(TO) recognize that sound is produced by vibrating objects.

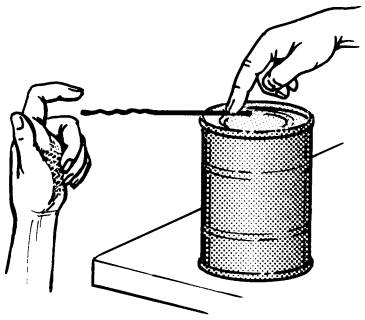
SOURCES OF SOUND ○ Sound ( )

1. Do each experiment and write what you observe:

a. Strike a tuning fork. While it is still humming, place the end in a glass of water.



b. Straighten a bobby pin. Hold it against an inverted can while you strum the end.



c. Touch your Adam's apple as you intermittently hum a low note.

2. What do tuning forks, hair pins, and vocal cords all do in order to produce sound?

3. Blow across the top of a soda bottle to make a note; tap on it with scissors. What vibrates to produce each sound?

Answers / Notes

1a. The humming tuning fork splashes water. (*Keen observers may notice that standing waves are generated on the water's surface between the prongs of the vibrating fork.*)
1b. The end of the bobby pin rapidly vibrates back and forth in a blur of motion that produces a sound.
1c. The Adam's apple vibrates the finger tips each time a note is hummed.

2. All of these materials produce sound by vibrating rapidly back and forth.

3. Air inside the bottle vibrates when you blow across the top. The glass bottle itself vibrates when tapped by the scissors. (*If there is disagreement over the source of the sound, don't rush in to settle it with the "right" answer. Value uncertainty as an opportunity to think, reexamine the evidence and learn something new.*)

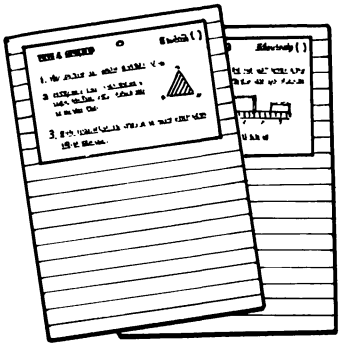
Materials

- ☐ A tuning fork.
- ☐ A glass or beaker filled with water.
- ☐ A "bobby" pin. These are not as common as they were 20 or 30 years ago, but are still sold in drug and variety stores.

- ☐ A can. Empty medium-sized cans, washed with labels removed, have wide application in this module.
- ☐ A soda bottle or equivalent small-necked bottle. Test tubes work too, if you can tolerate the loud, shrill whistle.
- ☐ Scissors.

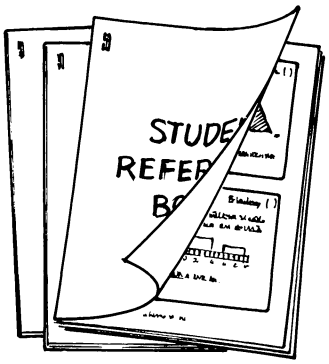
Task Cards Options

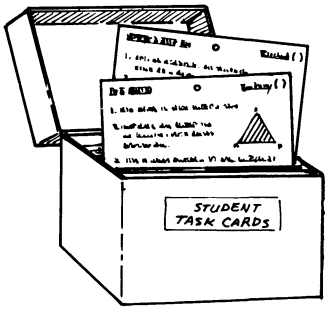
Here are 3 management options to consider before you photocopy:



1. Consumable Worksheets: Copy 1 complete set of task card pages. Cut out each card and fix it to a separate sheet of boldly lined paper. Duplicate a class set of each worksheet master you have made, 1 per student. Direct students to follow the task card instructions at the top of each page, then respond to questions in the lined space underneath.

2. Nonconsumable Reference Booklets: Copy and collate the 2-up task card pages in sequence. Make perhaps half as many sets as the students who will use them. Staple each set in the upper left corner, both front and back to prevent the outside pages from working loose. Tell students that these task card booklets are for reference only. They should use them as they would any textbook, responding to questions on their own papers, returning them unmarked and in good shape at the end of the module.





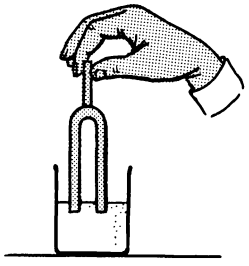
3. Nonconsumable Task Cards: Copy several sets of task card pages. Laminate them, if you wish, for extra durability, then cut out each card to display in your room. You might pin cards to bulletin boards; or punch out the holes and hang them from wall hooks (you can fashion hooks from paper clips and tape these to the wall); or fix cards to cereal boxes with paper fasteners, 4 to a box; or keep cards on designated reference tables. The important thing is to provide enough task card reference points about your classroom to avoid a jam of too many students at any one location. Two or 3 task card sets should accommodate everyone, since different students will use different cards at different times.

SOURCES OF SOUND

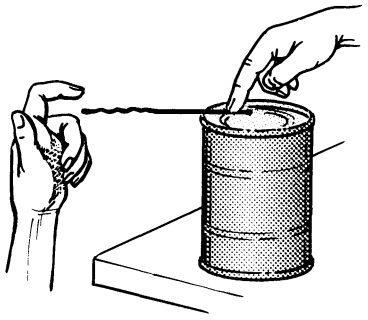
Sound ( )

1. Do each experiment and write what you observe:

a. Strike a tuning fork. While it is still humming, place the end in a glass of water.



b. Straighten a bobby pin. Hold it against an inverted can while you strum the end.



c. Touch your Adam's apple as you intermittently hum a low note.

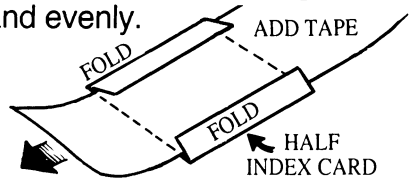
2. What do tuning forks, hair pins, and vocal cords all do in order to produce sound?

3. Blow across the top of a soda bottle to make a note; tap on it with scissors. What vibrates to produce each sound?

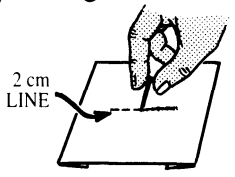
PENCIL WAVES

Sound ( )

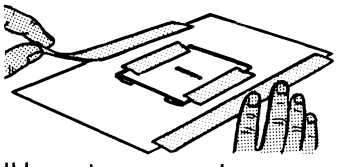
1. Cut an index card in half the short way. Fold one of its halves the long way around adding machine tape, so the tape feeds through smoothly and evenly.



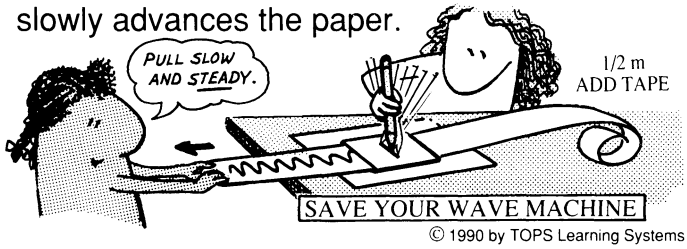
2. Open up a slot in the middle by poking a pin along a 2 cm line.



3. Tape it, flaps down, to another index card with masking tape. Then tape the index card to your table.



4. Insert about 1/2 meter of add tape into your wave machine. "Vibrate" your pencil rapidly back and forth inside the slot while a friend slowly advances the paper.



5. Tell how to generate wave trains with...

a. short wavelengths.

b. long wavelengths.

c. short wavelengths that grow longer.