TEACHER INFORMATION

Speed of Sound

1. Editable Microsoft Word versions of the student pages and pre-configured TI-Nspire files can be found on the CD that accompanies this book. See *Appendix A* for more information.

2. This experiment cannot be done with Easy or Go! Products since data collection rates are greater than 200 samples/second. The microphone requires sample rates around 10,000 samples per second.

3. In this experiment, you can use long tubes that are used for shipping equipment, tubes used for rolling carpet, and PVC pipe. Pipe with a diameter of 10 cm works well, but you may obtain useful results with a smaller diameter. If you use a larger diameter pipe, you must adjust your measurement accordingly (L + 0.4D where D is the diameter).

4. To create a closed end, a book can be placed against the end of the tube. Observant students will note differences if the book is gradually moved away from the physical end of the tube between successive trials. A tight seal is not required. Many packing tubes come with end caps that are convenient for this experiment.

5. Dog training clickers can be purchased at local pet stores. Finger snaps can be used as an alternative.

6. After the students start data collection, data collection will not begin until the sound level reaches a specified trigger value. It may be necessary to adjust this value if data collection begins too soon or not at all. If you need to adjust the trigger point, follow the directions in the student version of the lab. Monitor the sound level and then set the trigger level to be slightly larger than the current reading.

7. Reflections from the open end of the tube are inverted, while reflections from a closed end are not. This can be seen if a very short sound impulse is used.

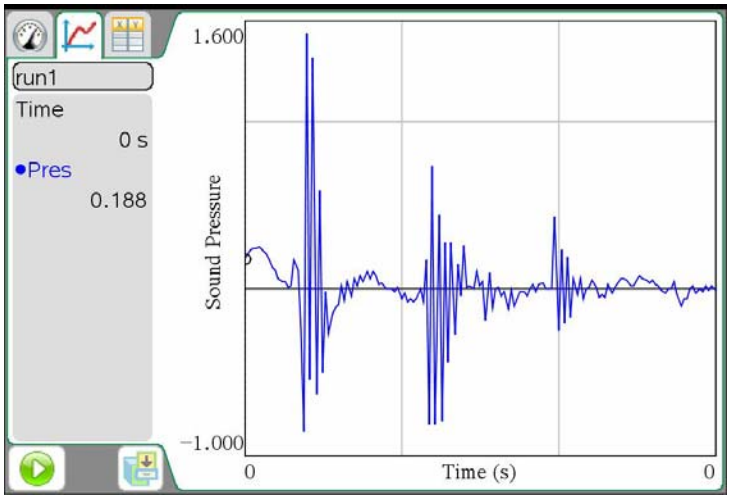
8. M. G. Raymer and Stan Micklavzina describe a method of studying sound impulses in a tube. Their technique is very similar to the technique used in this lab. They generate short pulses, making it easy to see the phase change upon reflection from an open end. For more information, see "Demonstrating Sound Impulses in Pipes," *The Physics Teacher*, March 1995.

ANSWER TO PRE-LAB QUESTION

The light from a lightning strike arrives almost instantly, while the sound is delayed by the comparatively slow speed of sound. Since you are counting once a second, then a count of five for a lightning strike one mile away yields (to a generous two significant digits)

$$\frac{1\,\text{mile}}{5\,\text{s}} \times \frac{5280\,\text{feet}}{1\,\text{mile}} \times \frac{1\,\text{m}}{3.28\,\text{feet}} = 320\,\frac{\text{m}}{\text{s}}$$

SAMPLE RESULTS



Temperature of room (°C)	22.7
Length of tube (m)	1.39

Trial	Time of direct sound start (s)	Time of echo start (s)	Time Interval (s)
1	0.0038	0.0118	0.0080
2	0.0030	0.0110	0.0080
3	0.0032	0.0112	0.0080
4	0.0006	0.0086	0.0080
5	0.0000	0.0080	0.0080
		Average:	0.0080

Speed (m/s)	347.5

ANSWERS QUESTIONS

The accepted speed of sound at 22.7 °C is v = 331.5 m/s + (0.607 * 22.7) = 345.3 m/s. Since the speed measurement is precise to two significant digits, the experimental result is in agreement with the accepted speed.