Interactive Notes-"Sound"

Materials (per group of 4 students):

Demo 1	1-slinky (item #WW66370M00 at sciencekit.com), in a sandwich bag
Demo 2	1-wire coat hanger 1-piece of foam block (the kind used to pack electronics into boxes)
Demo 3	1-pyrex flask- steamed and stoppered
Demo 4	2-tuning forks of different frequencies (or a ruler)
…and	4-note sheets (see last page)

Additional Teacher Materials:

PowerPoint (see last page)
Hot plates for boiling water and steaming flasks
1 pair-hot gloves
1-funnel- for pouring hot water into flasks
1-meter stick- to refer to when telling students how fast sounds travels

Beforehand:

- Set out all materials *the day before*. Leave yourself time to realize you're missing something, to practice the new demonstrations, research something, or even make a change. In the morning, read through the slides and notes one last time. Relax and have fun along with your students. Remember- you're only as effective as your plan.

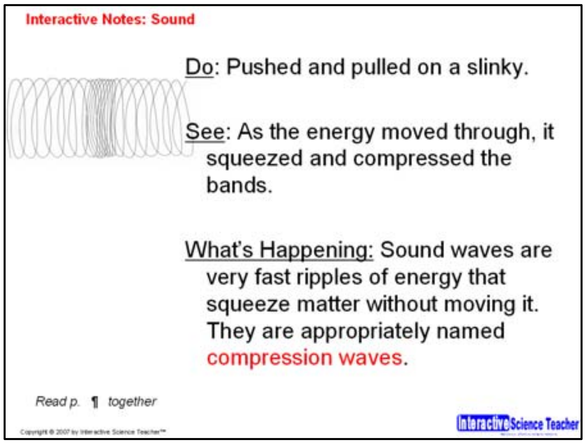
- Keep an extra wire coat hanger and foam block for yourself up front so you can show students how you want them to do demo #2.

- Insert page and paragraph numbers from relevant pages in your textbook at the bottom of slides 1 and 2 if you choose to have the class read from it together. This is a good way to connect with your textbook as well as transition into the next demo. You can also delete these page inserts, or Copy and Paste them onto later slides if needed.

- As with any other demonstration, try these out ahead of time for yourself so you know how they work best and so you know what to expect.

- Print extra copies of the notes pages on paper for yourself, students that are slow writers or can't see well, and for absentees. Click "File" → "Print" → then where it says "Print what:" select "Handouts" → and then "OK".

1.



Tell student #1 (of the 4) to remove the Slinky from the bag and hold onto one end of the Slinky while giving the other end to someone across from or next to them. Have them push on it with varying force, observing the energy waves that move through and echo back. Pause and ask what they think would happen if waves were sent in from both ends towards each other at the same time. After some suggestions, let them see what happens.

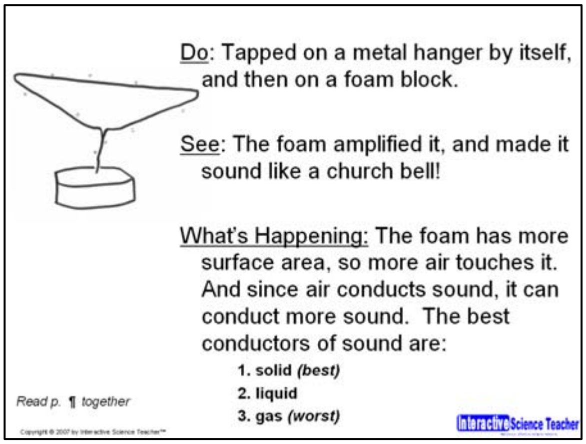
Most students aren't expecting to see the two waves ignore each other and just keep on going, but that's what they do. You could have been nice earlier and had them think about what happens when the rings from two different stones thrown into a pond meet (nothing, they ignore each other as well). Or that if they did interfere, then that means that so do sound waves, which means that two people talking to each other would hear nothing since the sound waves would meet in the middle and cancel out.

You don't need 8 Slinkys. Buy 3 or 4 and cut them into smaller sections, which actually helps in 2 ways- less cost, and less chance for tangles. And keep the Slinkys in baggies until the demo. That will keep students from playing with them too early, and lessen even more (but still not eliminate) the chance of them getting tangled.

Sound moves 340 meters per second through air at room temperature. Hold up the meter stick when you say this. Put another way- if you were standing 340 meters away with a drum and banged on it how long it would take you to hear it? (1 second). But you'd see it sooner, because light travels 1,000x faster than sound.

The speed of sound will vary. Sound travels faster through things that are more incompressible and lower in density. For example, it travels 6,000 m/s through granite, but just 54 m/s through rubber. The rubber converts most of the energy to heat.

2.



Have student #2 hold the wire coat hanger and hit it with their pencil. Ask what they hear ("A dull metal-on-plastic sound. Why are you making us do this?"). Then have them push the straightened end of the hanger into the foam (demonstrate what you mean by this) and then try tapping again.

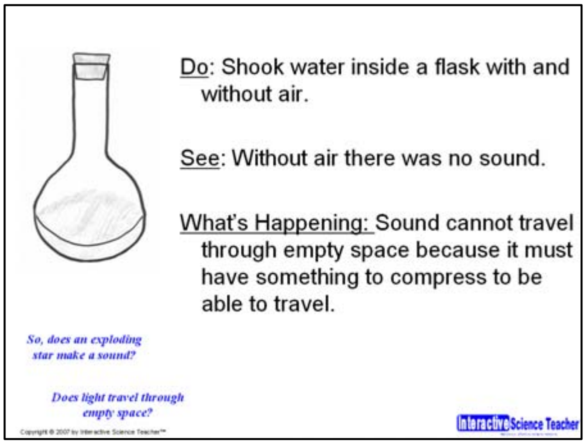
The hanger by itself sounds muted and dull when tapped. Almost like the sound is trapped inside… and that's because it is. It has a small surface area, so there's little air to conduct the sound. The foam block has more surface area than the hanger. When the hanger is struck the vibrations go into the foam. Since foam has much more surface area, there's more air touching it, so also a greater ability to conduct sound.

To prove to the doubters that solids are indeed the best conductors, try the knock test. Ask them to put and ear to their table and knock, so that one ear hears through the air and the other through the solid table. Which is louder?

Most students expect gases to be the best conductors because that's what they're used to. If you've been through a chapter on solids, liquids, and gases, recall that atoms in a solid are closer together, and in a gas they may be 50-100X more spread apart. That distance is what makes gases more inefficient, since it's through collisions of neighboring atoms that sound energy (compression wave) is carried.

Any kind of foam block will do. Don't go out and buy any. Use what comes out of electronics boxes.

3.



Have student #3 pick up and shake the air-less flasks of water, and watch their puzzled expressions when they hear nothing. Then have them pull the stopper, which allows air in, and shake it once again and listen.

To prepare flasks, pour some boiling water (about 10-20mL) into the flasks, and let them sit and steam on a hot plate set at 400° Celsius for 10 minutes, so all the air gets pushed out. Remove them from the heat and immediately stopper each shut to maintain the vacuum inside. Push the stopper down snug because at first the pressure from the uprising steam will be pushing on the stopper. *Caution: watch the flasks closely so they do not steam dry of water! Use Pyrex glassware only.*

You can use any kind of flask that you have rubber stoppers for- Florence or Erlenmeyer.

If you have enough flasks and stoppers, it would be wise to get *all* these prepared a day ahead of time. You'll save yourself tons of extra time and attention, which is going to be limited on notes day.

Two notes about the rubber stoppers:

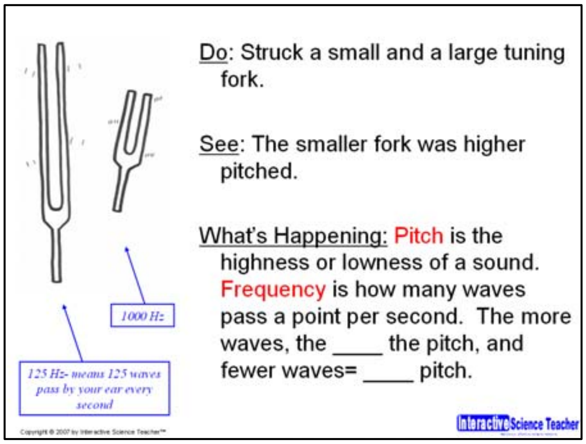
1.) Use longer ones so the person opening it has something to hold onto. If you use short ones that push almost all the way in, you won't be able to get a grip on it.
2.) Use stoppers that are not old and cracked- air will slowly leak through, spoiling your vacuum. Wooden corks don't work as well as rubber, for the same reason.

If you only have 1 set of flasks, you'll need to keep one or two large Pyrex containers continuously boiling with water so you can quickly re-steam the flasks as soon as you can get to them. If this is the case with you, pause right after demo 3 is done and get these going immediately (you can do this while students copy notes) if you need them next hour. It takes about 10 minutes to get them done if the water is boiling and ready, plus time to cool a bit to the touch. You might even consider switching this demo to be first to give yourself plenty of time to reset the flasks. To rearrange slides, open the PowerPoint, click on demo #3 and drag it up to the top spot.

If you do a really good job steaming your flasks, you might get a small water explosion when the tops are popped. That happens when a total vacuum is achieved, and when the air comes rushing in, it strikes the water inside the flasks and the force of it splashes some out. Even though I've only seen that once or twice, I still like to tell everyone about it right before they pull the corks, because I like scaring people.

Before opening flasks, ask students if they can see through the flasks, proving that light travels through empty space.

4.

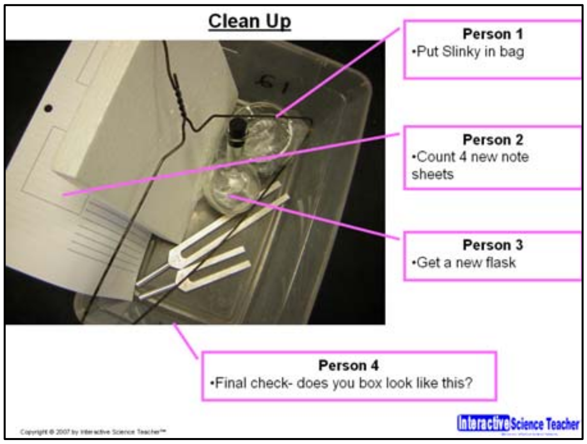


Before doing their demo, ask student #4 which of the two forks they think will have a higher pitch. Then have them strike them on either the sole of a shoe or the palm of their hand and bring it to their ear. The smaller one has a higher pitch. But why?

Answers: The more waves the HIGHER the pitch, and fewer waves = LOWER pitch.

Listen to the clarity of the forks. The 1,000 Hz fork sounds crystal clear, but the 125 Hz fork sounds grainy. That's because the 1,000 Hz fork has 8x as many sounds waves per second, making it more continuous.

If you don't have tuning forks, you can have the students flip a ruler as it hangs over the side of their desk and change the length.



Use this slide to direct students how to clean up and reset everything for the next class.

You'll need at least 5 minutes at the end of class to reset everything for the next class.

Leave out a stack of note sheets and new flasks.

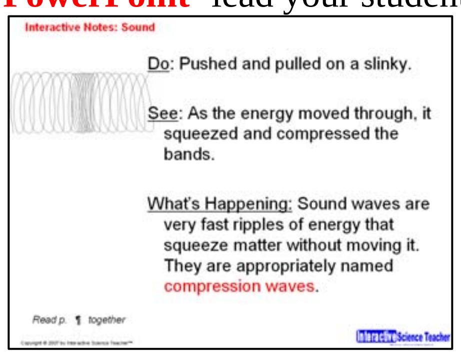
Have student #3 put their used flask on your desk so they don't get confused with new, unused ones.

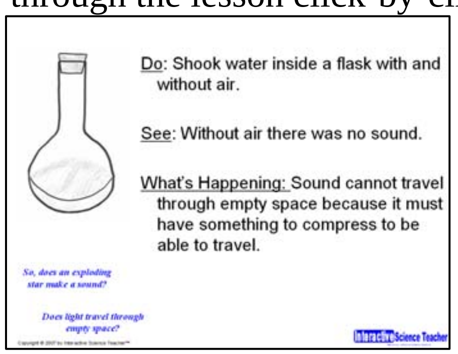
If you don't want this slide to show, right-click on the slide and select "Hide Slide".

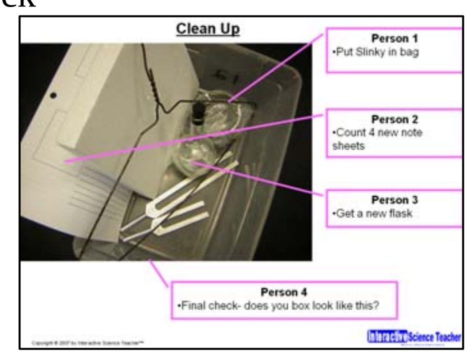
To help you with clean up, have your last science class take everything out of the boxes and put them in like piles in the back of your room.

Come back and visit InteractiveScienceTeacher.com to upgrade this lesson with:

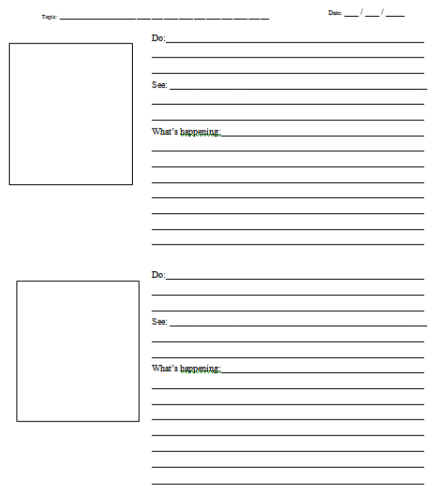
PowerPoint- lead your students through the lesson click-by-click







Student Handout



Topic: ____________________

Date: ___/___/___

Do: ____________________

See: ____________________

What's happening: ____________________

Do: ____________________

See: ____________________

What's happening: ____________________