Vibrating Sounds: Mscope label project for SciTech

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The Standing Wave exhibit at SciTech was relabelled to explain a simpler concept: that sounds are vibrations. The original labels were thought to be too obtuse, wordy and aimed at a older audience than the visitors to SciTech. We therefore remodelled the exhibit to explain one simple concept – that sound is air vibrating, and to make sure that the instructions on what to look for and do with the exhibit were clear.

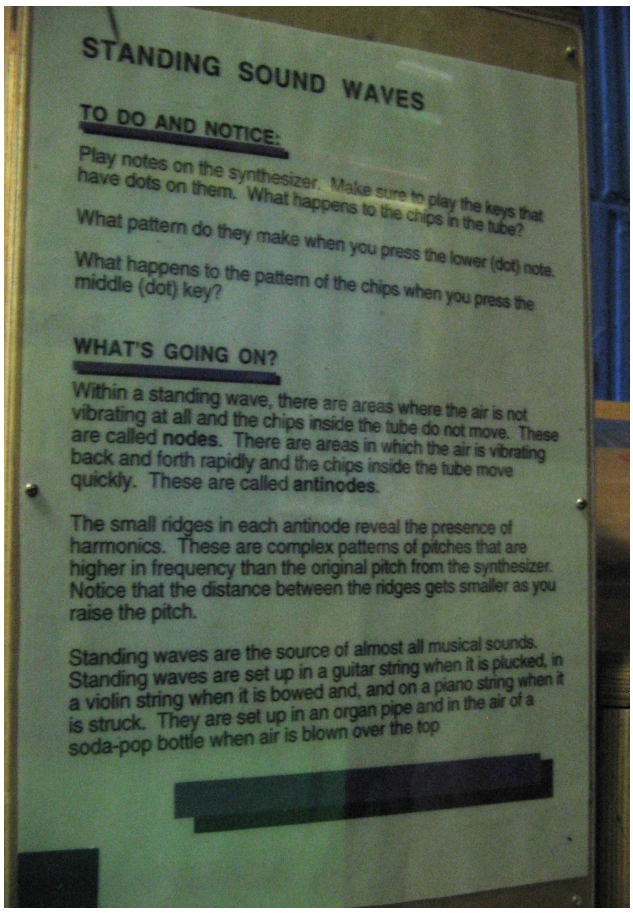
Original Exhibit

The exhibit consists of a piano keyboard, connected to speaker which is placed at the end of a long tube. The tube is filled with cork chips which vibrate when the keys are pressed. The chips start to vibrate, but gradually collect in lines along the tube. Different notes will make the chips collect in different places.

The exhibit is currently situated in the basement room at SciTech, which receives less visitors than the upstairs rooms. When it is being used it makes a lot of noise, so is quite attractive to small children, but when competing for attention with other exhibits appears fairly unexciting. There are at least three other exhibits in the same room that deal with standing sound waves.

The exhibit with its original labels

The original labels for this exhibit concentrated on explaining the concept of standing waves. The instructions were long, and referred to dots on the keyboard that no longer exist. The rest of the label was a three paragraph explanation of standing sound waves. As well as being too long, it was too complicated and visually unappealing.


STANDING SOUND WAVES

TO DO AND NOTICE:

Play notes on the synthesizer. Make sure to play the keys that have dots on them. What happens to the chips in the tube?

What pattern do they make when you press the lower (dot) note.

What happens to the pattern of the chips when you press the middle (dot) key?

WHAT'S GOING ON?

Within a standing wave, there are areas where the air is not vibrating at all and the chips inside the tube do not move. These are called **nodes**. There are areas in which the air is vibrating back and forth rapidly and the chips inside the tube move quickly. These are called **antinodes**.

The small ridges in each antinode reveal the presence of harmonics. These are complex patterns of pitches that are higher in frequency than the original pitch from the synthesizer. Notice that the distance between the ridges gets smaller as you raise the pitch.

Standing waves are the source of almost all musical sounds. Standing waves are set up in a guitar string when it is plucked, in a violin string when it is bowed and, and on a piano string when it is struck. They are set up in an organ pipe and in the air of a soda-pop bottle when air is blown over the top

The original label about Standing Sound Waves

First ideas and evaluations

Our original idea was to create labels that still explained the concept of standing waves, but in a far simpler form. We also wanted to add shorter instructions. Our first version had four different labels spread out over the exhibit. The texts were as follows:

1) Press different keys and watch how the chips move.
2) Sound is air vibrating. The vibrating air makes the chips vibrate too.
3) Different sounds are different sized vibrations.
4) Why do the chips line up? The vibrations move like waves. When waves bounce back from the end of the tube there are now waves going in opposite directions to each other. The

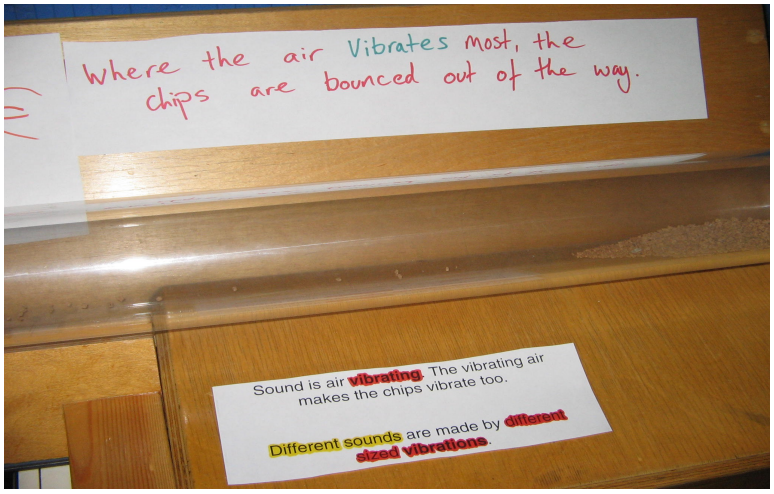
peaks and the dips of the waves can either add together of cancel each other out. There are places along the tube where the waves always cancel each other out. There are no vibrations here so the chips stop moving.

The fourth text would be either placed higher, or covered up so that it would only be read if the visitor was particularly interested in getting a more detailed explanation. The main three texts would therefore be very short and direct. Different colour coding of certain words would be used to make the most important concepts stand out. After experimenting with various diagrams we decided not to use any, because it would be too difficult to produce a static diagram of a standing wave that would not be confusing or off-putting We did, however, decide to put too labels on the keyboard itself – on two of the keys we put little colour-coded texts saying 'Press Me!'. Part of the reason for this was because not all the keys work and we wanted to direct the visitor to ones that did. But also to emphasise immediately what should be done.

Evaluations at SciTech of these labels showed that these labels were still too complicated, even when this short. They were therefore reduced further to a much simpler explanation that ignored the concept of standing waves, and to large instructions. The text became:

1. Press a key! See the chips move?
2. Sound is air vibrating. The vibrating air makes the chips vibrate too. Different sounds are different sized vibrations.
3. Vibrations move like waves. (With a complicated and rather confusing drawing)
4. Where the air vibrates the most, the chips are bounced out of the way.

These labels also tied into the explanation of standing waves given in some of the other exhibits in the basement.



Prototyping labels

Prototyping labels

Most children who were seen to play with the exhibit were roughly 7 to 9 years old. Almost without exception they ignored the signs and simply hit the keyboard as many times as possible to create a lot of noise. However, they did notice that it made the chips move. Adding a large label that said "Press the **GREEN** key THEN press the **YELLOW** key" made a big difference. After this the children would (eventually) press one after another and notice that there was a difference. When we asked them about the exhibit they were generally able to say something related to 'that the chips were jumping because of vibrations', 'that the different sounds produced different vibrations' and so on. Although they did not have a detailed explanation, or appear to be too interested in finding one, they seemed to get the main gist of the exhibit just from seeing very clearly the relationship between pressing a key and making something move. They also picked up on the word 'vibrations'.

Final labels

The final labels we produced concentrate on the concept that sound is air vibrating and do not attempt to explain standing waves at all. This was decided because the children did not seem to be interested in a longer explanation, or to comment on the fact that the chips line up in rows. The new labels support the exhibit more directly – they describe what is happening and what can be seen, as well as giving very clear instructions. There is one fairly simple diagram that uses an image of the keyboard that is in the exhibit. The final labels are:

1. (Directly over the keyboard) Press the **GREEN** key, THEN press the **YELLOW** key
2. (On two of the keys themselves) **Press me! Press Me!**
3. (At the side of the keyboard) Sound is air vibrating. The vibrating air makes the chips vibrate too. Different sounds are made by different sized vibrations.

4. (Above the tube and the keyboard) Vibrating Sounds! Sounds are Air Vibrating!
5. (A diagram showing a keyboard with different sized vibrations coming from the green and the yellow keys)

Proposed positioning of the labels

"Different sounds are made by different sized vibrations"