What is the Science?

Teacher's notes for "Old MacDonald – clucking cups"

Have fun making your clucking cups and then getting them to sound!

Pitch and String length

Since ancient Greek times, it has been known that the pitch of a vibrating string is related to its length. If you halve the length of a string (at the same tension), then the pitch will double. We hear this doubling of the pitch as an octave.
You can explore this using your clicking cup more easily by tying the string to something and then making it sound with the wet cloth. Make a second cup and use only half the string length and you will get an octave between the sounds.
It was Pythagoras that first explored the mathematics of music. There is an interesting web site at http://www.aboutscotland.co.uk/harmony/prop.html that allows you to explore what Pythagoras found more exactly.

Pitch and string tension

Think about a guitar – the strings are all the same length but make different notes. We tune the strings to particular notes by increasing (pitch is higher) or decreasing (pitch is lower) the tension in the string.
You can explore this with your clucking cups again by tying the string to something solid. You can then pull harder or softer to change the tension and change the pitch of the string.
The relationship between pitch and tension is much more complicated than between pitch and string length!

Measuring Pitch

As all sound is vibrations, we measure the pitch by counting the number of complete vibrations (cycles) per second. Scientists call "cycles per second" the unit Herz. If you have a piano, middle C sounds at nearly 262 Hertz. The octave above that is 2 x 262 = 524 Hertz and the octave below it is 131 Hertz. The note an orchestra tunes to at a concert is the A above middle C with a pitch of 440 Herz
If you explore Pythagoras and music, you will find that the major musical intervals are also simple ratios – Octave = 2:1, fifth = 3:2 and third = 5:4 (these form the major "chord" when played together on a piano).

Amplification

As you can see in the film, adding increasingly large "sound boxes" amplifies the sound. To be strictly scientific, amplification done this way (acoustic amplification) is actually best described as intensification: no additional energy is added to the sound as occurs with electrical amplification. This intensification uses up the vibrational energy of the string quite quickly, so the sound does not last as long as would be the case for an unamplified string.
You can explore this by listening to the three different clucking cups – the mouse, the chicken and the cow as each intensifies the sound by different amounts.